

The AMSAT[®] Journal

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CONTENTS

Phase 3D in Kourou and Ready for Launch.....1

Apogee View.....3
By Keith Baker, KB1SF

Return to Antarctica: A Digital Satellite Journal.....6
By Ronald Ross, KE6JAB

The Launch of JAWSAT.....13
By Cliff Buttschardt, K7RR

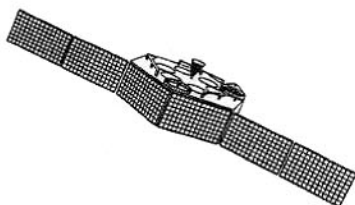
Bare Bones L-Band Uplinks.....16
By A. Michael Honer, W1BFN

Field Ops Update: AMSAT Area Coordinator Listing.....21
By Barry Baines, WD4ASW

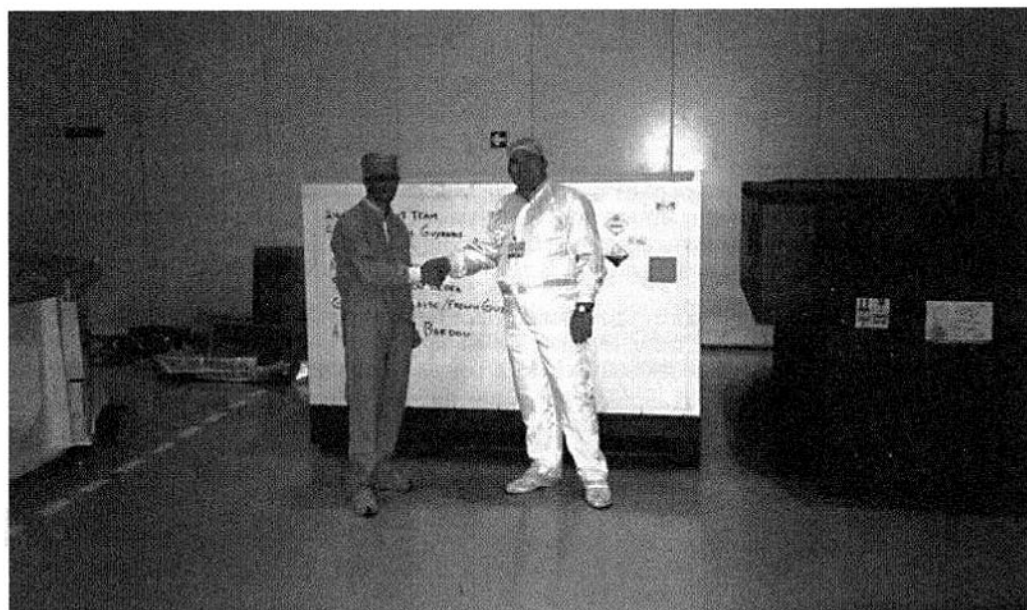
AMSAT Journal Telemetry.....24

Satellite Orbital Elements.....25
By Ray Hoad, WA5QGD

Amateur Radio Satellite Frequencies.....31
By Andy Reynolds, WD9IYT and Mike Seguin, N1JEZ



Please Support Phase 3D!



Mission successful! Phase 3D Operations Manager Peter Guelzow, DB2OS (r) accepts congratulations from an Arianespace official (l) on the completion of Phase 3D's journey from the Orlando Integration Laboratory to French Guiana. Presently, Phase 3D is stored in its shipping container in an air-conditioned integration-building at the Ariane 5 launch complex until the start of preparations for a launch. With all Phase 3D systems turned off and flight batteries uncharged, no AMSAT personnel are required on location during this inactive period. (AMSAT-DL photo)

Phase 3D in Kourou and Ready for Launch!

Phase 3D has safely arrived in Kourou, French Guiana and is now located at the ESA launch site in a cleanroom in the Ariane 5 Final Assembly Building. Shortly after Phase 3D's arrival to French Guiana, Arianespace listed their provisional launch manifest in the February edition of the Arianespace *E.space Newsletter* stating Phase 3D would be launched aboard Ariane 507, flight V132. The Ariane 507 launch window is tentatively scheduled to open on 27 July 2000.

[continued on page 4]

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Apogee View

Learning From Our Failures

By now, you should all be aware that Phase 3D has arrived safely at the launch site in Kourou, French Guiana to await a ride to orbit on an Arainespace Araine 5 launch vehicle. What's more, Arainespace has now (tentatively) set a window for the launch of Phase 3D that opens in late July of this year. Both of these developments bring us that much closer to having an operational satellite in orbit. However, as I have been saying for many months, a satellite sitting at the launch site in Kourou is still a far cry from one that is up and running in orbit.

The uncertain nature of what we in AMSAT continually try to accomplish was again brought home to us in just the past few months when an amateur-satellite laden launch vehicle was lofted into orbit via a converted Minuteman launch vehicle from Vandenberg AFB, California. Onboard were JAWSAT, OPAL, ASUSat1, FALCONSAT, STENSAT and others. As I write this, it has now become quite apparent that most of these satellites suffered one or more critical failures of onboard equipment so as to make many of them all but unusable for their intended amateur or other purposes.

As I have said in this column before, anyone who has not been directly involved in the design, construction and launch of one of these complex spacecraft simply cannot have the same deep awareness of the EXTREME level of uncertainty that faces any such group contemplating such endeavors. Besides the obvious uncertainties of never having enough skilled hands and brains (or time) available to build them, there is the added uncertainty of low (often non-existent!) leftover cash for parts, integration, as well as test and transport of the satellite. This is in addition to trying to design and implement innovative ways to account for the myriad of uncertainties associated with thermal, radiation and vacuum extremes that the spacecraft will encounter in orbit. Then there is the minor (?) concern of placing your brainchild on top of a big bomb (a.k.a. "rocket") specifically designed to hurtle it into the cosmos at several times the normal force of gravity.

Needless to say, each and every step along this tortuous path to orbit is fraught with opportunities for "failure." In AMSAT we are continually reminded that what we do is not for the faint of heart. In fact, because of our non-profit, "do-it-on-a-shoestring" approach to financing, simply completing a satellite and delivering it for launch is often a miracle in and of itself. Fortunately for me, over the years I've garnered a much deeper (and far more positive) meaning of the term "failure." That is, I've since come to view failure as a very necessary, if not absolutely critical part of the learning process.

Like many thousands before him, my dear departed Grandfather at the ripe old age 20 or so from arrived Europe at Ellis Island in New York Harbor with nothing but the shirt on his back (and an eighth grade education in his head) in the earlier part of the 1900s. After many years of self-teaching, he was later fortunate to have an opportunity to work as a tool and die maker (as well as a co-inventor) with Thomas Edison (of light bulb and phonograph fame) in Edison's West Orange, New Jersey laboratories. I'll always remember how "Pop" (as our family called my Grandfather) shared story after story with me about what it was *really* like to work side by side with such a famous inventor.

Looking back on it now, I'm also glad I had the good sense to actually listen!

According to Pop, Edison's basic approach to inventing things in his later years was to simply hire a large cadre of workers (like my Grandfather) who were then encouraged to go invent things. The basic method of doing so was a trial-and-error approach where creating a long series of failures was highly encouraged. In fact, Edison regarded failure as an absolutely essential and critical part of the learning process. In once instance, Edison was being hounded by a media reporter of the day for his "failure" to invent an ordinary storage battery, very much like what we now have in our automobiles today. In response to this reporter's unrelenting persistence on the subject, Edison was reported to have said, "I haven't failed at anything, Sir, because I now know 250,000 ways it *won't* work...that's knowledge, NOT failure!"

And, research study after research study has proven the worth of Edison's basic approach. The bulk of that research has since shown that we humans learn *far* more effectively from our failures than from our successes. That is, if we succeed at something without ever knowing why, we haven't really learned anything. How many times have we as Hams tied to chase down an intermittent failure in a piece of our own equipment? Banging on the side of the case may fix it for a time, but we still don't (and won't) know the exact cause of the failure from such activity. Only after the culprit component completely quits do we have our best hope for finding the cause and then fixing the problem.

And such is the nature of what we do in AMSAT. Because of the myriad of extremes our satellites must face on their way to orbit, the only way we can learn if a new approach to satellite communication *really* works or not is to go try it, recognizing full well that we might be inviting sure failure in the process. Now, certainly, it's nice to get things right on the first try. But the chances of doing so are always *far* less than 50-50, particularly when it's the first time out of the chute with a new design.



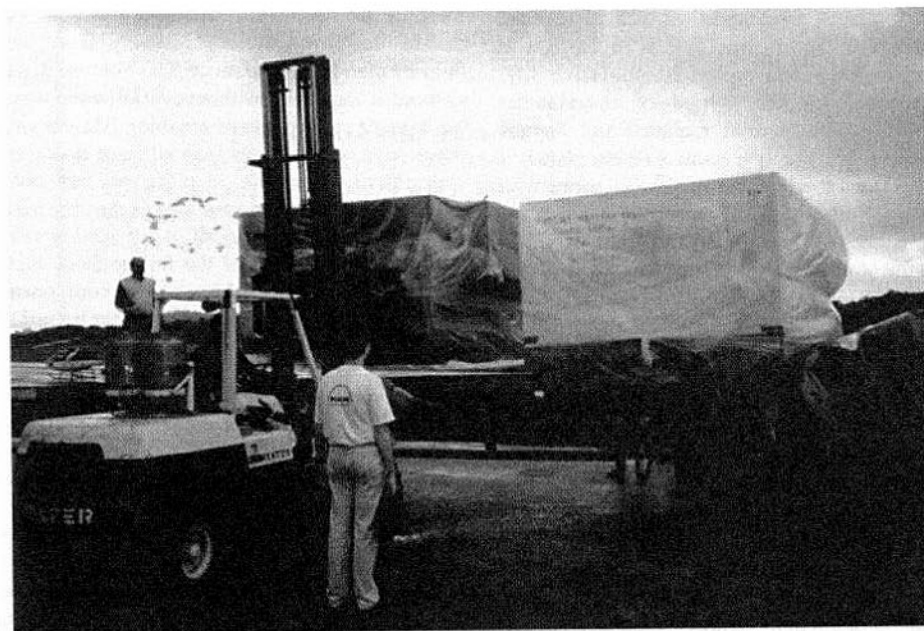
The arrival of Phase 3D at Cayenne, French Guiana via an Air France Boeing 767 from Paris, France. The container with the Phase 3D satellite weighs approximately 1000 kg, the second container with the SBS-adaptor and test equipment weighs approximately 1600 kg. Both containers just barely found room in the cargo hold of the 767 aircraft. (AMSAT-DL photo by Peter Guelzow, DB2OS)

So, to those experimenters who are now mourning the loss of their latest crop of new satellites I say "take heart." In return for dedicating most (all?) of your lives over the past few years while building your spacecraft, you have now learned a number of valuable lessons to share with your fellow experimenters for next time. And, the very least the rest of us can do is to try and understand that *everything* we do in space, regardless of the outcome, is a learning

experience and therefore has *great* value...even when those experiments don't work out the way we had all hoped. As Edison would say, "that's knowledge, not failure!"

For this reason, along with myriad others, we need to continue to give our experimenters all the respect and encouragement we can collectively muster.

— Keith Baker, KB1SF ■



The transport of Phase 3D and the SBS containers to Kourou. The journey that was over a distance of 70 km was carried out by a truck convoy. (AMSAT-DL photo by Peter Guelzow, DB2OS)

[continued from page 1]

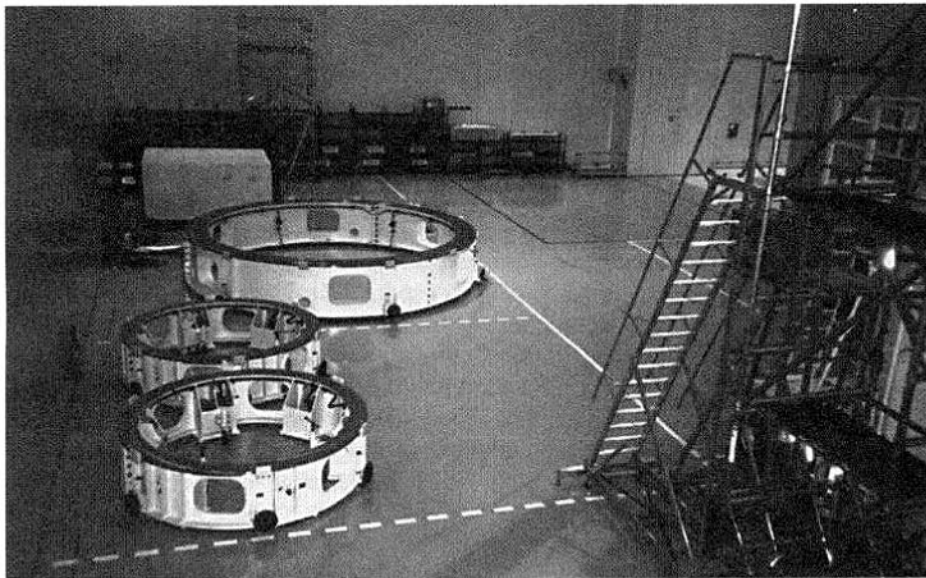
The Road to French Guiana

The two containers storing Phase 3D and the SBS were transported by truck from Orlando, Florida to the Hartsfield International Airport in Atlanta, Georgia with an escort of the Orlando Integration Laboratory AMSAT team members. On 17 January 2000, Phase 3D's journey continued on to Paris on a cargo aircraft and from there, on a Boeing 767 to Cayenne in French Guiana. There was no routing possible except via Paris, since there are no direct flights from the USA and even by making many aircraft changes, the aircraft would simply have been too small. Both containers just managed to fit into the cargo hold of a Boeing 767 as the container with the AMSAT Phase 3D satellite weighs approximately 1000 Kg, and the second container with the SBS-adaptor and the test equipment weighs about 1600 Kg. Subsequently, Phase 3D was taken to the Ariane Launch Center (Center Spatial Guyanese) in Kourou, French Guiana. During the journey, Phase 3D was accompanied by Bob Davis, KF4KSS and Jay Ramdas, both colleagues from the Phase 3D Orlando Integration Laboratory, and by Peter Guelzow, DB2OS, the Phase 3D Operations Manager.

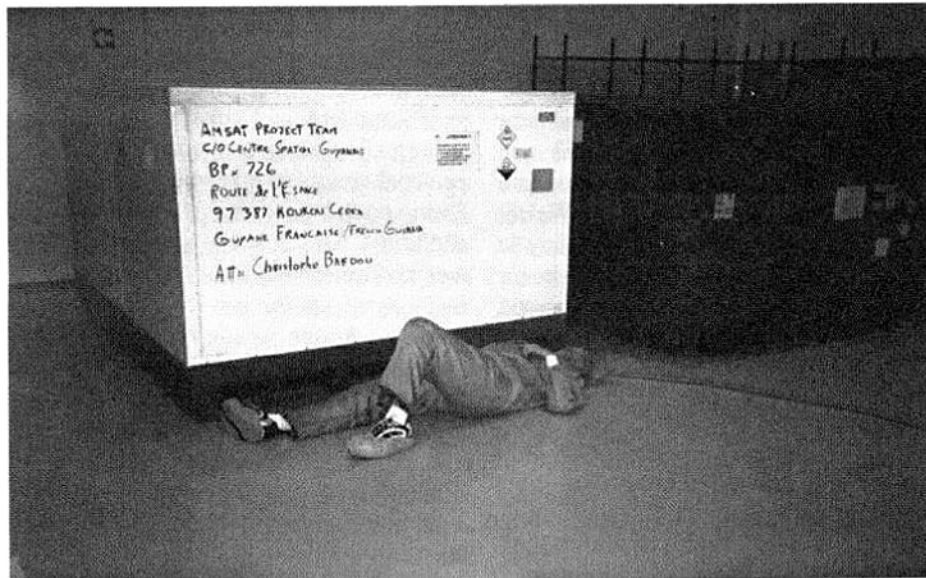
The Phase 3D is being stored in a climate controlled integration building at the launch site until actual the start of the launch preparations. Phase 3D remains in a passive state with all systems turned off. Even the flight batteries have not been loaded. As a result no AMSAT personnel are required to remain on site with Phase 3D.

Phase 3D Tentative Launch

On 29 February 2000, a week after Phase 3D's arrival to Kourou, AMSAT-DL's Peter Guelzow, DB2OS, broke the exciting news via amsat-bb by telling the Amateur Radio satellite community that "it's official" — the Phase 3D next-generation Amateur Radio satellite has been tentatively scheduled for launch in late July! The launch information is included in the Arianespace Provisional Ariane Launch Manifest for February through July of this year. The manifest appears in the February edition of Arianespace's *E-space Newsletter*. If this tentative schedule holds, the Phase 3D satellite would be sent aloft on Ariane 507, flight V132.



The huge Final Assembly Building (BAF) for the Ariane 5 launcher. This is where payloads are mated to the Ariane 5 launcher. At this site, there is another huge building called BIL, which is the launch vehicle assembly building. (AMSAT-DL photo by Peter Guelzow, DB2OS)



Purging the Phase 3D spacecraft container with nitrogen while in the Ariane BAF. (AMSAT-DL photo by Peter Guelzow, DB2OS)

AMSAT-NA President Keith Baker, KB1SF, was delighted with the news, "slowly but surely, Phase 3D is moving ever closer to a launch. To finally see it listed on a launch manifest is a major milestone. Needless to say, we're most grateful for all the outstanding support we've been getting from the fine people at Arianespace!" AMSAT-NA Board Chairman and former President Bill Tynan, W3XO, echoed the statements, adding, "the recent news that Phase 3D has been designated for launch on AR-507 was indeed gratifying to all who have waited so long to hear such tidings. As the President of AMSAT-NA during much of the time the spacecraft was being

constructed at our Orlando facility, I am especially pleased that the hard work of so many, for so long, is now coming to fruition. I look forward to meeting many of my friends on Phase 3D once it becomes operational."

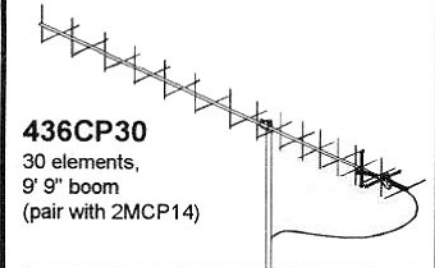
The Arianespace manifest identifies the other possible payloads aboard flight 507 as the PAS-1R (Europe Star) package and the STRV-1C/1D package. A launch contract accepting Phase 3D as a payload for the first suitable Ariane 5 launch vehicle was signed in October, 1999. The satellite is now at the European Spaceport in Kourou, French Guiana. ■

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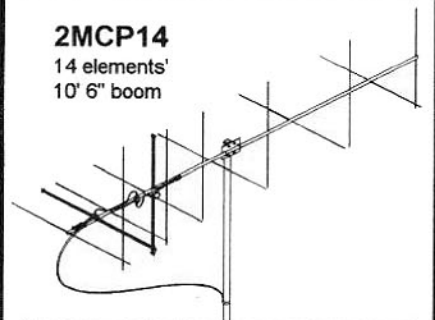
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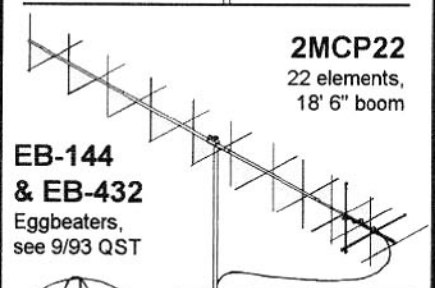
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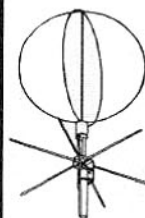


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Return to Antarctica: A Digital Satellite Journal

Ronald Ross, KE6JAB

January 1, 2000: *The Start of the New Millennium*. We looked back to see if the DC-3 had left. We had been pulling our sledges for only 15 minutes and already we badly needed to stop and rest. But not wanting to be seen resting by the DC-3 crew, we had to press on. From behind the plane, crew kept on watching us. Our adventure had just begun!

Planning for the Return

In 1997 my wife, Sheryl, and I first traveled to the interior of Antarctica. During that trip we visited the South Pole and took several short camping trips in and around the Ellsworth Mountains at 80S, 81W (see "Blue Ice Transmissions: Amateur Satellite in Antarctica, December 1997 - January 1998," *The AMSAT Journal*, March/April 1998). When we arrived in Antarctica that first time, we *recognized* the isolated beauty of the landscape and the nature formed by such an extreme climate. It was a familiar feeling for us, similar to our adventures when camping and exploring the *high desert* areas of Nevada and California.

Upon our return to our home in San Francisco, we thought often about Antarctica and returning there. Returning to the Ellsworth Mountains did not appeal to

us. We were interested in something a bit more challenging and remote. A year later we came across a book detailing an expedition in an area called Dronning Maud Land (DML), Antarctica. This book described a fantasy landscape of mountains and glaciers seen only by a handful of explorers. DML was in the Norwegian sector, at 72S, 8E, almost halfway across the continent from where we had been on our first trip. The book and the area it described became the impetus for our return to Antarctica.

In February 1999, we started planning our return trip. How do we get to DML? How long would it take? What logistics were required? Those types of questions were first and foremost in our minds. It took months of research, planning and agonizing over choices before these questions were answered.

On our first trip I took a minimal PACSAT station and communicated with other hams using the amateur satellites, UO-22 and KO-25. Each day I uploaded photos and reports about our excursions to Roy Welch, W0SL and Jerry Smyth, K8SAT. They in turn forwarded those files to our website for others to view and read. This was successful and a lot of fun. I decided to do this again for

the trip in DML. Yet, only this time I would require a more versatile station.

We decided our trip to DML was going to be a cross-country skiing/sledging expedition. We would pull all our gear, food, tent and supplies behind us in sledges. We would ski around three mountain ranges covering a total of 100 miles. This was to take place over a three week period during December 1999, the height of summer in Antarctica.

Pulling sledges requires all things to be as light as possible! We could be moving camp on a daily basis. The station might have to be assembled and disassembled every day. We expected temperatures in the area to range from +20F to -20F. The new station had to be light, mobile and robust to withstand the cold and harsh environment.

Throughout the summer, I evaluated computers, radios, antennas, batteries, solar panels, modems and cameras. In addition to pulling all of our gear, we were limited to a personal weight allowance of 50 lbs each! Every pound over that would cost us an additional \$30. I knew sticking to these weight limits would be impossible as the radio gear from the last trip alone weighed 35 lbs. A drastic weight reduction in radio gear was desperately needed to save on cost alone never mind the physical problems of transportation.

The previous trip I had taken a 12 volt/17 amp hour battery that weighed 13 lbs. It seemed reasonable to use a lighter battery like lithium that was also capable of withstanding low temperatures. On most polar expeditions HF radio is used for personal communications and a lithium battery is used to power the radio. The operator usually does not have the luxury of time to wait for recharging by solar power and can't rely on the clear weather. I talked to most of the large battery companies and got several solutions.

In the end I decided against using a lithium pack because of the battery cost, the hazardous transportation cost, and I would have needed to take an additional pack as a backup since these packs were not rechargeable. Instead, I chose a sealed lead acid battery. It did weigh 21lbs more than the two lithium packs but cost several hundred



Ronald, KE6JAB, pulling sledge away from the DC-3 on 01 January 2000. (Photo by Sheryl)

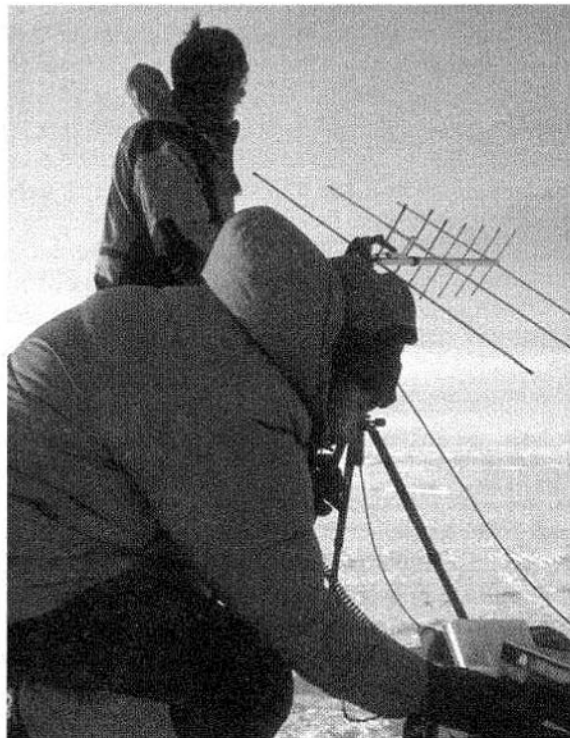
dollars less. I had used a solar panel with a lead-acid battery before and I now I planned to do the same for this trip.

By the end of the summer I had some solutions for the amateur satellite station but still felt like they were not the best ones. The type of antenna to take was the most troublesome of all. On the last trip I had taken a pair of M2 Eggbeaters. They worked best on passes with high elevations and were too much of a problem to assemble and disassemble on a daily basis. I had also built a pair of Eggbeaters from a design by Jerry Brown, K5OE. Those worked better and had a broader pattern, but I still didn't feel like this was the right choice for the task at hand.

In October 1999, I attended the AMSAT Annual Meeting and Space Symposium in San Diego. This was a great opportunity to meet other hams and gather practical ideas from those I knew from AMSAT-BB. I finally met Jerry Smyth, K8SAT in person and he suggested that I try the Arrow dual-band Yagi antenna. Until now I had only been considering omni-directional antennas. Pointing a directional antenna required another pair of hands in addition to those working the radio and laptop. This did not simplify things, but I did ultimately go with the Arrow. I met Mike, KF4DMJ who demonstrated to me a satellite prediction program which ran on the Palm Pilot. This turned out to be one really useful tool that saved using the laptop and its precious battery power. I also met Dave Guimont, WB6LLO. He had a complete PACSAT station setup in the parking lot of the hotel. He was using the IC821 satellite rig, which I also had. I took note of some good practical tips. The symposium was a windfall of ideas and tips, which helped to crystallize the station configuration.

One of my biggest fears was to arrive in Antarctica without some vital piece of electronics or camping gear. Therefore, I compiled a list of all the necessary components. For weeks our living room floor was covered with the gear we planned on taking. As often as I could, I assembled the entire PACSAT station on my roof from only the contents laid out on the living room floor. I made sure everything worked on the pass, then disassembled it. All items were checked and rechecked, some things discarded some things added. During the final packing, I was tempted to throw in all types of things that ultimately wouldn't be needed or used. I still found it hard to remain disciplined and leave certain things behind.

In early October, we thought that the logistics of the expedition were firm. Our travel plans to DML were to begin in Capetown, South Africa. From there we would fly 11 hours on a LC130 Hercules plane directly to *Blue One*, our Antarctica base-camp located in Dronning Maud Land. Around the beginning of October this plan was canceled. The entire trip was in jeopardy because several people had backed out at the last minute making the cost of chartering the plane too high for the remaining



Ronald, KE6JAB, and Max Wenden working UO-22 during an evening pass.
(Photo by Sheryl Schindler)



Ronald and Sheryl just before departing Punta Arenas, Chile aboard a Hercules LC130 bound for Patriot Hills, Antarctica.

group. This was the worst possible news. With so much work done it seemed impossible for things to end up this way. We were not about to give up. Telephone calls and e-mails went back and forth for weeks. A solution was to fly from Punta Arenas, Chile on the Hercules to a base-camp called Patriot Hills (where we flew to our first trip). Then fly a ski-landing gear equipped DC-3, onward 1200 miles to DML. This was a bit drawn out route but that's what we had to deal with.

The Long Trek South

On 03 December 1999, we made our way to San Francisco airport, with a load of 200 lbs between us, not counting food, fuel and tent. We were not quite sure how or if we would manage to pull this load! This first flight, though we didn't know it at the time, would be the first of twelve plane trips before we began our expedition.

One week later, we arrived at Patriot Hills (PH), 80S, 81W our first base-camp in Antarctica. We were introduced to 24-hour sunlight and +20F temperatures. This was the main operations camp for the expedition company. From here clients moved out to their destinations in Antarctica, whether it be to the mountains, the South Pole, or like us to the other side of the continent. Several aircraft were based here including two Twin Otters, a Cessna, and the DC-3 that would take us to DML.

We anticipated a short stopover at PH, of one or two days. Without delay, I began to assemble the PACSAT station. The beauty of the Arrow antenna, other than weight, is the short time it takes to put together and how small it packs down. I had practiced often at home in putting the entire station together and could do that in about 15 minutes. The first upload attempt was a low pass of UO-22 over PH. I prepared a message to send to Roy Welch, W0SL. The signal from UO-22 was very strong and I thought it would be a cinch of an upload. Yet for some reason the satellite did not hear me. The next pass was slightly higher, I thought for sure I'd be able to upload. But again no connect! I was beginning to get worried. Everything had been working fine back home, but now with no contention on the uplink I couldn't connect. After a sleepless night I tried again the next morning with a very high pass on KO-25. On cue, we uploaded our first message of the trip. The fear about having broken equipment or having to fix something evaporated quickly. A day later, I did connect with UO-22, and we put that first experience down to 'cockpit error.'

The weather at Patriot Hills deteriorated quickly after our arrival and several days later a very big storm developed in the region. This brought lots of snow and winds in excess of 90 mph. It blew away a couple of tents, buried us in several feet of snow and damaged equipment in and around the

base-camp. I had never experienced anything quite as ferocious as this and hoped we would not see weather like this in DML. We had been warned about a storm the previous year at the DML base-camp; one that had blown away the entire camp.

At PH, we stayed in a large tent. I had enough room to track the satellites from inside the tent using the Arrow antenna on a tripod, this was a real blessing since it allowed me to upload when the weather outside was *unfavorable*. During the expedition, we would be using a very small tent and there would barely be enough room for two people let alone swinging an antenna around inside. I didn't relish the prospect of transmitting from outside the tent in bad weather and I worried about how to maintain the batteries if we had overcast weather and couldn't use the solar panels.

On to Blue One

For two weeks we waited at PH for a break in the weather. Finally on Christmas Eve, eleven of us left for DML on the DC-3. There was great excitement throughout the aircraft. Three hours into the flight, the pilot told us he was turning back to PH because the weather ahead had deteriorated. After much discussion we found a hole in the cloud layer and landed at a place called Berkener Island. There we celebrated Christmas in an igloo! Once the weather cleared we hopped from fuel cache to fuel cache. The day before New Years Eve, we finally reached our base-camp, *Blue One*.

Blue One is located on a *small* patch of snow in a large blue ice field. Nobody had been at Blue One for a year and we spent the better part of a day putting together a small camp, which included our tent and one large dining tent. Since our departure for Blue One a week earlier, I hadn't sent any messages on the satellites. After tent building I assembled the PACSAT station and sent a message to W0SL letting him know that *against all the odds* we had finally arrived in DML and were ready to start our expedition. One month later than planned!

Before leaving the base-camp for the mountains we had one more task to complete. Throughout the year I had been helping a student, Holda Biskeborn, KF6VIC, build a remote weather station. Holda was a student of Professor Robert Twiggs, KE6QMD at Stanford University. We designed a weather station to periodically transmit data from five sensors using a MIM module and a 1 watt, FM



Ronald Ross, KE6JAB, working KO-25, using his sledge for an outdoor bench top. (Photo by Sheryl Schindler)

transmitter. The data was sent in APRS format. We could decode the data on a Kenwood TH-D7 handheld, or connect to a laptop and store it. Our plan was to place the station high up on a nunatak behind Blue One, with a three-element Yagi antenna pointed in the direction of the mountains where we would be skiing. Each day we would gather several transmissions and retransmit the data in a file over the PACSAT back to Holda at the Stanford OSCAR station.

We had planned to ski from Blue One to the mountains located about 25 miles away. Because we had lost so much time due to bad weather, we decided to reverse our expedition route and omit this distance. The DC-3 would drop us off at the furthest western point of our route then we would proceed to ski towards Blue One over the next three weeks. That furthest point was line of sight, and 42 miles from the weather station. I wasn't confident of picking up the transmissions from that distance and wasn't sure how long it would take us to get within range.

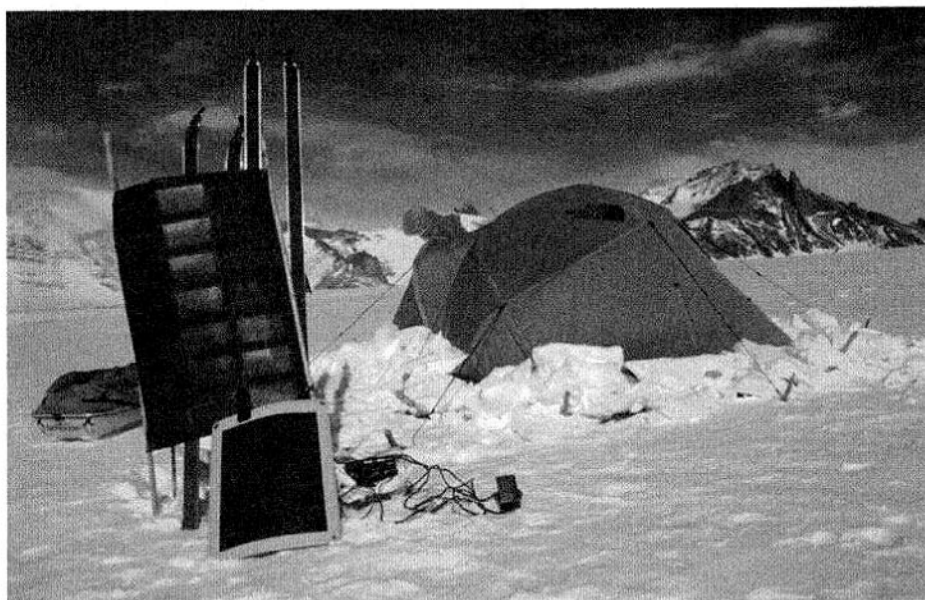
Trekking the Rakekniven

On the morning of 01 January 2000, we pulled with all our strength up the 2 mile incline from where the DC-3 dropped us off to the base of *Rakekniven*, (a Norwegian word for Straightedge Razor) a 900-foot monolith of rock, that has been climbed only once and seen close by less than a handful of people. The last month of pent-up frustration literally forced us up that first stretch. When we reached close enough to base of the mountain we stopped. Exhausted and *rubbery legged* we made our first camp.

There were three of us, Sheryl, myself and Lisa our guide. Lisa was an *all around guide* from England who looked thin and never ate much, but had stamina and endurance that never failed to surprise me.

Her husband Max was one of the DC-3 copilots, he would join us a few days later when the DC-3 went back to PH. He had a fascination for all things electronic and a keen interest in learning more about the PACSATs.

On our own, with the *umbilical cord cut*, we left all the problems of the past month behind and got down to making our way across this beautiful landscape. First off, we climbed to the base of the Razor wall. At its side was a small peak, two hundred feet above the local elevation. We thought that



The daily ritual of recharging. I used two flexible solar panels to recharge my main 12V battery. To the right is a small solar box for recharging AA batteries. (Photo by Sheryl Schindler)

from its top we might be able to pick up the transmission from the weather station. The route to the top of this peak was first up a 60 degree inclined ice sheet which we climbed using our crampons. The top of this peak gave us a nice panorama of the surrounding area and clues on how we could navigate across the terrain. To our great surprise, we saw two Snow Petrels flying around the wall of the Razor. What did those birds live on in this sterile environment where nothing moved but the snow, wind and ice?

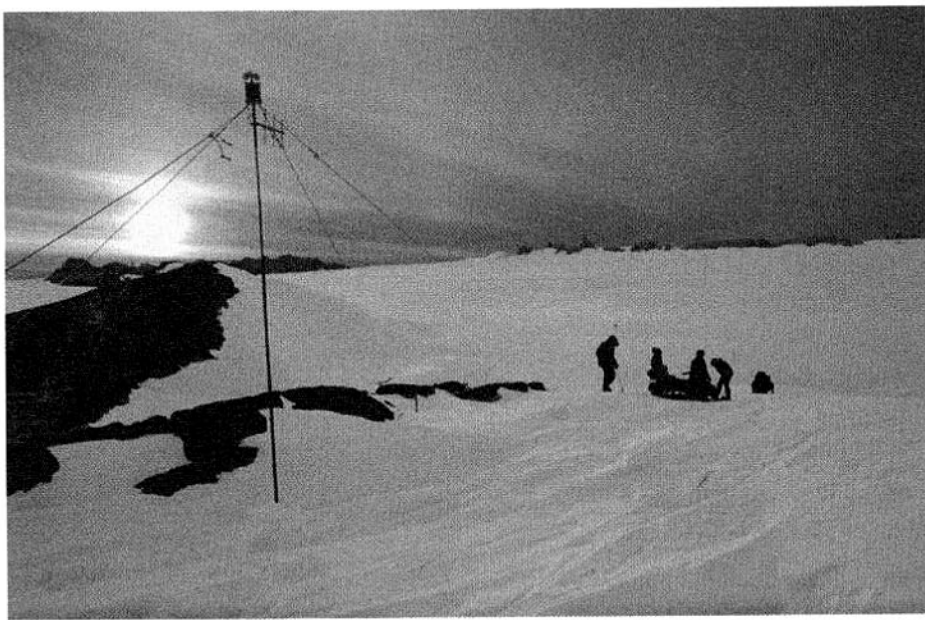
Patiently at the top, we waited with the Kenwood HT for the packet burst from the weather station 40 miles away. On cue, there was a slight dip in the noise and a very faint burst but way too low for any serious decoding. We thought we could see the nunatak on which the weather station stood but were never quite certain. Hopefully, the battery-operated station would continue transmitting until we got much closer. On the way down from the peak, I discovered a hole in the ice sheet. With a bit of prodding from my ski stick this turned out to be a really big hole, one that we had crossed on the way up. I decided not to think too much about this and continued on down, very quickly!

On our first night at the Razor, I assembled the PACSAT station and waited for the next evening pass of UO-22. We changed our time zone to UTC which was done to keep

high noon the hottest part of the day. The passes for both birds started around 2000 UTC and ended at 2300 UTC. In the morning there were a number of passes beginning at 0500 UTC ending around 0900 UTC. That generally was the pattern for this area. The sun never set, but after 1800 UTC the heat from the sun was barely noticeable, its angle low in the South. The temperature started to drop gradually and by 2000 UTC it could be 0F. It was not unusual to see -20F by 2300 UTC. Around 0400 UTC the temperature decline reversed, as the sun rose again.

The station was set up on my sledge. It was partially covered to stop light snowflakes falling on the electronics. I'd been standing around for an hour getting my feet frozen. I knew if I went into my tent and waited for that pass I'd have to get into my sleeping bag, and once in the bag I was not coming out till the morning. It was 2300 UTC by the time UO-22 came over and it had gotten really cold! I managed to upload a photo and a report to W0SL, but I could see a pattern emerging for the next few weeks that didn't look too inviting.

The next day we woke to a clear blue sky and a bright hot sun. I took full advantage of this sunlight. I laid out both the solar panels for charging the 12Volt battery and several small solar boxes capable of charging 4 AA batteries simultaneously. Battery charging



The Stanford University weather station built by KF6VIC and KE6JAB. It sits atop a nunatak near Blue One Base Camp. The Yagi antenna is pointed towards the Fenristunga mountain range. (Photo by Sheryl Schindler)

was to become something of a ritual for me. I could never rely on long periods of sunlight and often, when moving between camps I had a solar panel strapped across my sledge in order to charge batteries as we skied. For flexibility I also carried a small linear regulator that could take a higher voltage and supply anywhere from 13 to 3V to a device or battery.

When Max joined us a few days later we had moved camp five miles to the south and were within view of an icefall named Kubus. Several times during the warmest part of the day, we heard a distant rumble similar to thunder and spotted large clouds of ice crystals billowing in the air. This was the result of several hundred tons of piled up ice crashing down the icefall. It was an impressive sight but an unnerving sound.

When I was doing satellite uploads, Max wandered over to see how this system worked. It was a curiosity that I had to capitalize on. I began to show him how to track the satellites with the Arrow antenna and use the pass prediction program on the Palm Pilot, Pocketsat. Each day, we ran the program to check the times, direction and angles for the day's passes. The nice thing about the Palm is that it draws little power, is small and compact, and can fit in a pocket. It was referred to often waiting for the beginning of a pass. It saved me from powering up the laptop till the beginning of

a pass. This was critical since the laptop batteries suffered badly in the cold temperatures and would not hold their charge. I had three spare batteries but could barely keep one charged. Later in the trip, I resorted to powering the laptop constantly from the 12Volt lead-acid battery.

For the next several days, we moved our sledges and supplies across the frozen landscape exploring the mountains and the mountain passes. We had a planned route but decided we would take things as they came. There would be no hard and fast rules about being somewhere at a certain time for no reason other than scheduling. We adopted the general idea of camping for a few days in one place and then moving on once we had absorbed the local scenery. Each new camp appeared to have better scenery than the previous one. We knew the Fenristunga range would be spectacular and this was one big carrot that continually drove us forward.

The sledging days began around 0600 UTC when we would eat a hearty breakfast to fuel us on our way. At all times we each had a flask of hot water. It was important to drink plenty and often. When the temperature dropped suddenly, a good hot drink was essential. We'd tear down the tents and have everything packed into our sledges by 0800 UTC ready to go. We skied until noon, with a short break every hour to check navigation.

In the afternoon, we would repeat this pattern till we made it to the next camping spot. It was best to stop around 1600 UTC when the sun still had some heat in it. The camp could be established in reasonable temperatures and the evening meal prepared before it got too cold to stand around outside.

Often, we had a satellite pass just after our evening meal. Max and I refined our tracking techniques with the Arrow sometimes using a tripod, but often just holding the antenna. Our goal each night was to get everything uploaded on the first pass of either satellite. If we failed, it could mean waiting 90 minutes for the next pass while the temperature dropped steadily. If the wind rose or a light snow began we just packed it in for the evening. With the two of us working the station together, we started to send more photos. We also began to receive messages from others seeing our dispatches on the satellite directory and our website. The evening ritual had become more fun and less work. We all looked forward to that part of the evening and whether each pass might bring a new message. Most evenings, we ate by 1900 UTC, afterwards everyone retired to their tent and remained till 0600 or 0700 UTC the next morning.

By the end of the first week, we had skied across the two mountain ranges and now made camp on the edge of a large ice-field several miles wide. We had a large glacier to cross before making it to the Fenristunga range. This distance was 12 miles and uphill. The map showed a gap between the mountains that could be a shortcut. Before trying it we decided to stop and check it out. Our campsite was on a rock strewn slope that led down to the ice field. Each one of us had the feeling that we were camping on a *beach* with the vast ice-field as our *ocean*.

On a trip like this, you spend all your time with your companions 24-hours a day. There is not much privacy. Therefore on days when not moving camp one person would remain behind while the others went on a day trip or did reconnaissance for the journey. I was having my *day off* when the others scoped out this possible shortcut. They found the shortcut was not an option, it was too steep and treacherous for pulling our sledges up. But, on their way back they spotted a large curl of snow that was formed from the wind as it blew over the edge of a ridge. Lisa and Sheryl ice climbed up to the center of the curl and described it like a

surfers dream wave as they looked down the frozen *tube*. This was just one of the many wonderful displays nature had created in such a harsh and hostile environment. It was anything but *just ice and snow*.

Above our campsite began the Vinjebreen glacier crossing. It was to be one of the most dangerous days of the trip. We first encountered narrow, long slots in the ice, nothing too troubling but they could swallow your ski pole if not careful. Looking into those slots revealed an icy, "rotten" crack with a gorgeous blue light emanating from the depth of the hole below. Further along, the slots became wider and longer, some wide enough to fit a car into, a few could take a house. They were not open gaping holes but were identifiable from the depression in the snow that formed a drooped bridge across the gap. I exposed holes in the thin top layer of snow and looked down several but couldn't see the bottom. We roped together, forming a chain with our sledges, 300 ft. end to end protecting us in case someone fell in a crevasse.

For seven hours, we navigated our way across the crevasse field, trying to cross wherever there was a narrowing of the slot. Sometimes too much snow was covering the slots, then you could never be sure what the next step might bring. By the end of this day everyone had fallen into a hole, most of the time up to their waist. The tight rope between us stopped further falling. Even so, we were gripped with terror each time this happened. After five miles the crevasse field thinned out and ended. We were tired and relieved and decided to make camp. Our position that night left us high on the glacier with no protection from a stiff wind blowing down from the polar plateau. We had with us a bottle of rare Scotch whisky and kept it for moments of celebration. That night we each had a couple of tots of whisky and secretly felt lucky to have made it through a very tense and trying day. We hoped it was the last of the *blue holes*.

We had deposited a small cache of supplies in the Fenristunga Range before beginning our ski trip. The next day we made it off the glacier and found our way to the cache.

Our new campsite placed us 30 miles from Blue One. I was eager to try and listen for the weather station transmissions. Using the Arrow, a preamp and the Icom we listened and sure enough on cue we were able to hear the faint Morse code signal from the weather

station. The others were nearly as happy as I was. The station was still ticking away and obviously had plenty battery power left. A day later, we skied to a higher spot where we could see Blue One and the nunatak where the weather station was located. Using the Kenwood HT, I got a strong signal and was able to decode the telemetry fine.

For almost five days, we enjoyed clear blue skies in the area. Our campsite faced a semi circle of mountain peaks, each 2-3 miles distance from our camp. We took day trips to explore all the peaks. The good weather also gave us an opportunity to recharge all our batteries, ourselves and take account of the remaining supplies.

Max and I had by now worked out a good system for working the sat-passes. At will, we could upload over 150k per pass. We took several digital pictures of this area and uploaded two 180-degree panoramas of the mountains as we saw them from our tents. The mountain peaks were a mixture of tall columns, spires, pyramids, fang-like teeth all carved by glacial action. It was wild spectacular scenery we never tired of.

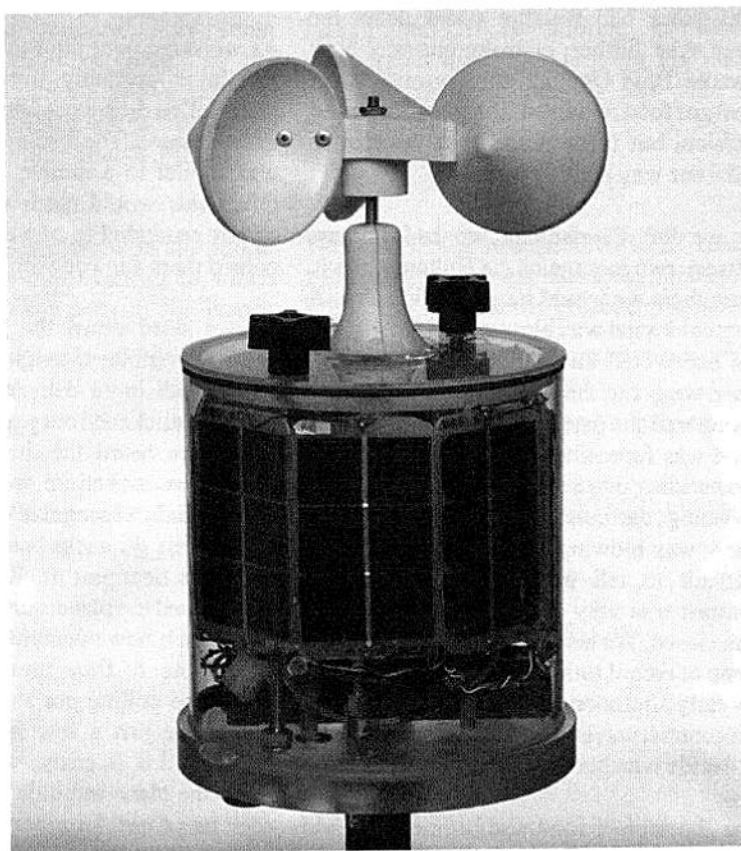
In addition to my communication equipment, Max carried a HF radio and an Iridium satellite phone. Just two years before on our first trip, the Iridium service did not exist. Now, nearly every expedition had one. I was a bit ambivalent about this instant communication with the entire world. Once at Patriot Hills base-camp several phones were ringing together and you could hear people talking to friends in New York, Paris and London etc. Having traveled so far to get here. I felt, slightly cheated by the invasion

of the *outside world*. Saying this the convenience of the Iridium phone could not be denied. To use the HF, we had to string wires out across the campsite and listen to a very noisy weak signal. Instead, each night at 2100UTC we turned on the phone for 20 minutes and waited for any calls to come in. Every other evening Max phoned a German Polar research station 200 miles away to our West and spoke with Heidi. She supplied us with weather predictions for our area. They had Internet access, and followed our progress from the photos and reports on our website.

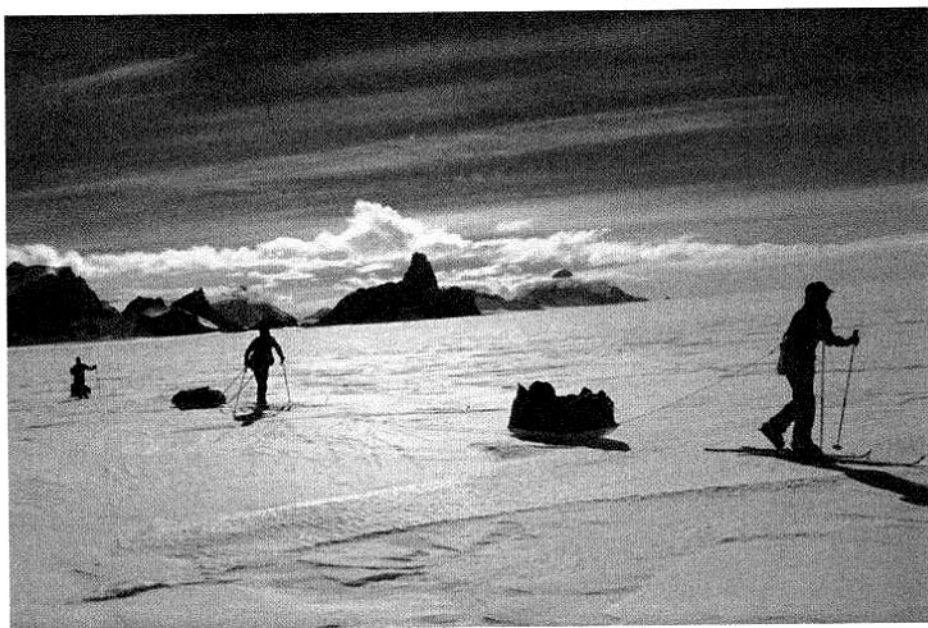
The Long Trek North

Our daily contacts with the PH base-camp kept us briefed on when the DC-3 would return to pick us up. Originally this had been scheduled for the 15 January 2000, then changed to the 16th then the 17th. Our food supplies would only last us to the 20th.

During our nightly schedule, we learned that the DC-3 would not be coming for several more days. At PH, a group of scientists some from NASA and two former astronauts, Jim Lovell and AMSAT life member Owen Garriott, W5LFL were waiting to begin an expedition to collect meteorites in the Thiel mountains. The DC-3 was required to ferry



Close up of the Stanford Weather Station. (Photo by Sheryl Schindler)



Lisa, Max, and Ronald pulling the sledges to the next camp with the familiar face of *The Razor* in the background. (Photo by Sheryl Schindler)

them from PH to Thiel, then to the Pole and back to PH. Only after completing those trips could it come and pick us up. With this information and our current food supply, we were faced with a choice of whether to stay in the area till the DC-3 returned. This was risky since bad weather could delay the plane even further, or make our way back towards Blue One 25 miles away, where plenty of food remained. It was an unpopular decision, but to be prudent we decided to make our way back to Blue One.

As we left Fenristunga we had to pass between two mountains via Holtannapassat. From there we would travel to Blue One. A very cold wind was blowing off the glacier. We expected this wind would be cut off when we got to the entrance of the pass. As we entered the pass, it was obvious that the wind was funneling through the pass itself and building into a blizzard. After two hours of skiing the conditions were worsening. Snow was blowing into the air and it was difficult to tell up from down and the contrast was very poor. For now, the pass was closed. We headed for shelter and made camp in record time to wait out the blizzard. By early afternoon, the wind had moderated, the contrast was still poor and it was difficult to decide whether to continue.

The shortage of food was beginning to add a sense of urgency to our decisions to get back to Blue One. We broke camp that

afternoon and made it through the pass in marginal conditions. We had three days food left and it would take us three days to reach Blue One. *It's a strange thing, but when you know you are short on food you seem to feel hungry, all the time.*

As we skied over the snow in this area the top layer suddenly dropped by several inches. This drop would fan out for hundreds of feet around. The resulting sound from this was similar to a rumble of an earthquake. Often this would catch us off guard and briefly reminded us of a crevasse drop. We coined them *snowquakes*.

As we skied down the glacier Blue One became visible through our binoculars. Faced with more dehydrated food or real food we quickened our pace. With five miles to go, we heard the drone of an aircraft engine, we looked up and saw a plane. At first we didn't recognize it as the DC-3. We waived our ski sticks back and forward but the plane flew past us. With signal mirrors we targeted the plane, surely it would see us, but again it flew over without a twitch of the wings. As it flew into the distance we continued pulling our sledges toward Blue One, now just a few hours away. I was thinking this is crazy, we had no way to *radio* the plane and didn't know if they had seen us or not. I suggested we contact the base-camp at Patriot Hills with the Iridium phone. They would be *flight following* the

DC-3, we could pass on our present coordinates and they could relay them to the DC-3.

Afterwards, we learned that the pilot had seen us but did not land because he feared crevasse in our area. Another 30 minutes later the DC-3 did return, it circled overhead then landed within 200 feet of us.

At this point in time I knew our trip had ended. A day later we tore down Blue One, and buried everything back in the ground as we had found it. It was now Wednesday 19 January 2000. We took one last look at the mountains climbed aboard the DC-3 and left for an eight-hour flight back to PH. In a goodwill gesture to us, the pilot flew back over the Fenristunga at an altitude low enough for us to see our ski trails and the snow walls of some of our previous camps. Those remnants of our stay would last only a short while longer, the memories of such a trip will endure a lifetime.

On 27 January 2000 the weather conditions were good enough for the Hercules to come and pick us up and 37 other clients from Patriot Hills base-camp. Just seven hours later at 0300 we landed in Punta Arenas, Chile. It was our first night of darkness, our first bath and a soft bed in over two months!

This is AMSAT!

Many thanks to all the people who sent us messages over the satellites. It would not have been possible without the help of Ed Anderson, KE6IZN, Roy Welch, W0SL, Jerry Smyth, K8SAT and to many others who helped along the way, thank you. The complete set of messages and photos from the expedition are available on our website, at www.thistle.org along with the list of radio equipment we took along.

It should be noted that for that season in Antarctica, to my knowledge, no one else using commercial radio gear or otherwise, was able to successfully send back pictures and images from the *field* as we had been able to do. Even at 9600 baud it is still a fitting tribute to those that built and launched those satellites and to those that maintain them. They are a great resource and a treasure we must recognize. They need to be built upon to make possible even greater speeds of access for the mobile user.

Thank you AMSAT, wherever you are!

Ronald Ross, KE6JAB ■

The Launch of JAWSAT

Cliff Buttschardt K7RR (k7rr@amsat.org)

Last October 1999, I received a telephone call from Randy Kohlwey, N7SFI who was at Vandenberg Air Force Base where he was working feverishly on JAWSAT. Randy was calling to ask if the local southern California AMSAT members could drop by the assembly area and discuss providing assistance in assembling and operating a ground station for JAWSAT post-launch activities. Taking them up on their offer, we quickly located the assembly building, where we found both Randy and Assi Friedman, KK7KX, of Arizona State University busy completing a variety of programming necessary for launch. This was our quick introduction to JAWSAT after being asked to assemble a ground station.

It is first helpful to understand that JAWSAT is a complex subsystem of an even larger system in which a two-stage Minuteman rocket is topped with another two-stage assembly. Hams have a habit of being rather myopic in not realizing that the main payload of this launch, a MINOTAUR, pays the launch fee while our Amateur Radio efforts are entirely secondary payloads. Most of the successful OSCAR launches are now being accomplished this way. That is, OSCARs are often flexible ballast that can be discarded at any moment. We might as well get used to the idea that this may be the way that Amateur Radio satellites will be launched in the future. That is, it just is too expensive *not* to use one carrier for multiple birds.

As shown as Figure 1, JAWSAT had six payloads attached to its structure. One of the payloads attached to JAWSAT is OPAL which was designed and constructed by Stanford University. OPAL contained six picosats of which STENSAT and Artemis (Thelma, and Louise) transmitted on Amateur Radio frequencies. Also on JAWSAT were two Weber2 and PEST payloads from the Marshall Space Flight Center. While PEST did not use Amateur Radio frequencies, Weber2 used downlinks of 437.175 and 437.070 MHz. JAWSAT was also tasked to release ASUSat-1 which was designed and constructed by Arizona State University (see September/October 1999 issue of *The AMSAT Journal*). While it is somewhat difficult to describe all payloads associated with the JAWSAT packages, Figure 2 provides a list of satellites that have downlinks on Amateur Radio frequencies.

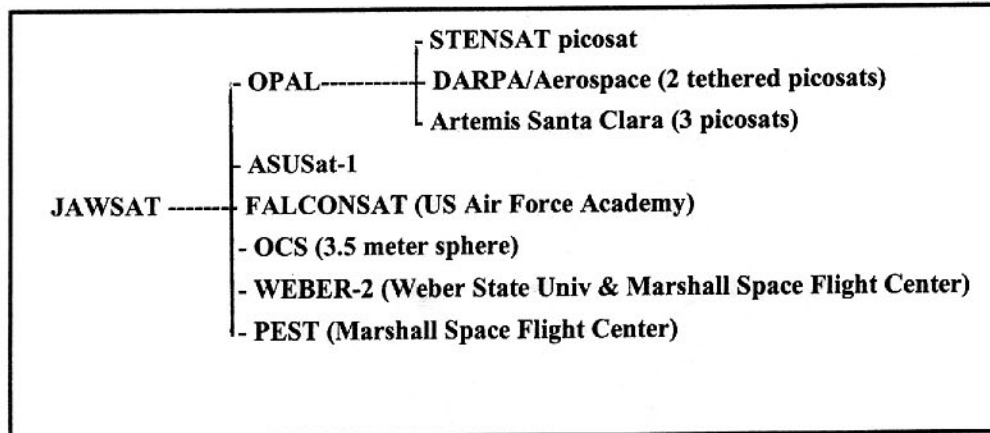


Figure 1. JAWSAT Configuration

The First Try

The first attempt to launch JAWSAT from Vandenberg Air Force Base was scheduled for the evening of 07 December 1999 which was a bitterly cold day with fog whipping by the coastline. That afternoon we were treated to a tour of the launch area that is a commercial launch site stripped to essentials in an attempt to reduce costs (Figure 3). Note that there is also no silo, rather only large scaffolding and lots of canvas enclosing the rocket. Hot air is pumped inside the canvas and the canvas is removed only when necessary as the solid propellant in the Minuteman must remain above 40F degrees. As a result, the scaffolding is removed during the last minutes before launch by a farm tractor!

team reported ready and able. During the briefing, the large use of acronyms made it confusing to those not directly associated with the launch, however some acronyms were understandable. The team responsible for weather reported conditions were currently in minimums, safety indicated no ships in the area, medical indicated three ambulances were ready and on duty, and other teams reported in a similar go status. Finally the base commander shouted in a very loud voice *Go!* That was very understandable! Unfortunately however, the launch had to be aborted as weather deteriorated with increasing fog that caused visibility to deteriorate to less than one hundred feet.

The Second Try

After the launch site tour we were allowed to sit in on a military-style briefing in which each of the responsible parts of the launch

The launch was re-scheduled to 22 January 2000, however it was not to be then either. While the countdown proceeded almost to

Satellite	Frequencies
JAWSAT/WEBER2	437.175 MHz and 437.070 MHz 9K6 packet telemetry
OPAL	437.100 MHz 9K6 packet
STENSAT	436.625 MHz downlink and 145.840 MHz uplink
ARTEMUS that contains:	
JAK	437.100 MHz CW
THELMA	437.100 MHz FM/FSK 1200 baud
LOUISE	437.100 MHz FM/FSK 1200 baud
ASUSat-1	436.700 MHz downlink

Figure 2. Satellites with Amateur Radio Frequencies on JAWSAT suite.



Figure 3. MINOTAUR in the fog at Vandenberg AFB launch site, 07 December 1999.

zero, some ground equipment malfunctioned causing a hold in the countdown. Since this was a commercial launch, temporary repairs were made and the effort continued. Meanwhile, we were allowed to view the launch pad area from a site some three miles away. The brisk wind and cold coming off the Pacific were significant and caused most to leave the site early. Three hours after the hold, the countdown was restarted and continued to almost zero when a loud and clear abort! abort! abort! echoed over the launch viewing area. We later learned the internal battery voltage had dropped too low to allow launch.

The Third Try is a Charm

On 27 January 2000 another launch attempt was made. Fortunately, the JAWSAT launch delays allowed us to assemble our AMSAT ground station with better equipment. The station was located at Roy Ellis' W6QJ home in Lompoc, California. Originally my entire satellite station was re-installed at W6QJ.

However, because of the launch delays, W6QJ spent a significant amount of his own money for new gear in order to be sure that operation commands could be issued during the first orbit (Figures 4 & 5). To successfully command JAWSAT required the combined equipment of three Amateur Radio satellite stations, a dozen computers and five operators. Included in this operation was relay of the launch status to the AMSAT community via amsat-bb. As a result, lots of advanced planning and coordination took place; remember this when you attempt to access a satellite with an HT and expect instant results!

As a result of our ground station operation duties, we were just too busy to go to Vandenberg to watch the third and successful launch. However from our W6QJ ground station sight in Lompoc, CA, we watched a perfectly beautiful rocket rise into a cloudless sky at 0303 UTC. After the first orbit, JAWSAT telemetry was copied by all five

operators. We thought that we had success as we had to first hear from JAWSAT before the other satellites could be commanded and released.

Success and Failure

Since these were University/Amateur efforts no one ever thinks failure and the satellite is the end product of many people learning along the way. Sadly, on 03 February 2000, KK7KX issued the following e-mail on amsat-bb:

Hello Everyone: Sorry we were holding off for a while, we wanted to make sure we are right. Unfortunately, it appears that the ASUSat1 has passed away. Telemetry we received with the great help of the South-African SUNSAT team indicated that the batteries were not receiving any charge from the solar-array. Due to this, the satellite worked for about 15 hours on battery power alone. We have no further indication that will help us pinpoint the exact cause. The only thing we can say is that the problem probably happened between the solar-array and the power-board. The ASUSat1 team was disappointed but yet very happy. The satellite provided interesting telemetry when it was alive, and we are analyzing that at present. We were thrilled that the system powered up and did what it was supposed to. Its not every day you have a box in space beeping at you. In any case, the team is looking forward to future missions! If you know of any free launches let us know! assi kk7kx/4x1kx

Meanwhile OPAL continued to transmit telemetry on 437.100 MHz but in a sporadic fashion that was not easily understood. STENSAT and ARTEMIS were deployed on 19 February 2000 with W6WYQ and K7RR present at the Stanford dish during the release. Unfortunately, few have heard any signals from these picosatellites since they were released. Radar returns confirmed the picosatellites were launched and were separating from OPAL. An amateur satellite station in Morro Bay, CA, relayed highly distorted signals from STENSAT. Meanwhile, Jamie Cutler, KF6RFX, Randy Kohlwey, N7SFI and Bob Twiggs, KE6QMD continued to try and contact these picosats. Of the suite of Amateur Radio satellites, only OPAL is producing telemetry signals. Later STENSAT chief designer, Hank Heidt, N4AFL posted the following to amsat-bb:

Based on a test performed earlier this evening, we think there's a good chance that STENSAT is alive, but in an abnormal operating mode. The pico was supposed to power up in telemetry mode, and there have been no reports of received packets. But during the 8:30 EST pass over Washington DC, Hank transmitted a solid continuous tone on the uplink frequency and detected a signal (S2) on the downlink. This same experiment performed after the pass produced nothing. There doesn't seem to be any other explanation except that STENSAT is active. We would appreciate it if others would attempt this experiment and report back, so we can verify if our theory is correct.

The STENSAT group is asking amateurs to continue monitoring the downlink and send any reports (via e-mail) to hheidt@erols.com. More information is available on the STENSAT WWW site at <http://users.erols.com/hheidt/>

An Epilogue

As of the end of February, Ed English, W6WYQ and I became satellite mentors to Cal Poly in San Luis Obispo, CA where we are helping with the design and construction of a JAWSAT-type launcher to orbit twelve more university-built satellites. Three cubesats are being built by Cuesta College and Cal Poly. Each satellite is an individual education project being assembled by a team of students who are learning at a rate far in excess of that normal in a school environment. Indeed, we are fortunate that many people are willing to donate endless hours!

It simply would not be proper if I were to conclude by ignoring the notion that satellite design, construction, launch, and operation is for the faint of heart. Certainly while synchronous orbits will have to wait until the laws of physics apply, the use of low power handhelds using FM are modes that will not be easily accommodated by these new satellites. Some have indicated this effort is for the rich ham; however this is not at all so! These projects are for those willing to learn, with flexible attitudes, and the ability to join a new generation of ham radio. The old OSCAR/AMSAT facilitators are quite tired so now let us progress on to the next phase by noting where we are going rather than where we have been. ■



Figure 4. JAWSAT Command Station Team at W6QJ ARS, Lompoc, California. From left to right: Paul Michelsen, KC7QFS; Bob, KD6BTO; Randy Kohlwey, N7SFI; Ms. XYL Ellis and Roy Ellis, W6QJ.

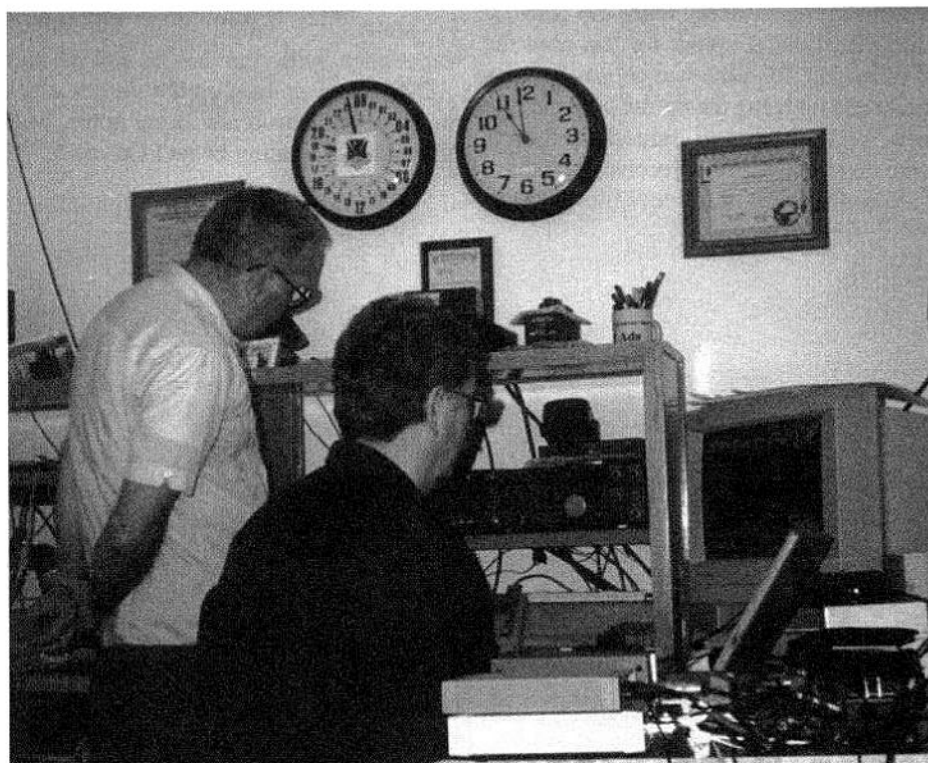


Figure 5. Roy Ellis, W6QJ (l) and Randy Kohlwey, N7SFI (r) busy at work at the JAWSAT Command Station.

Bare Bones L-Band Uplinks

A. Michael Honer, W1BFN (w1bfn@aol.com)

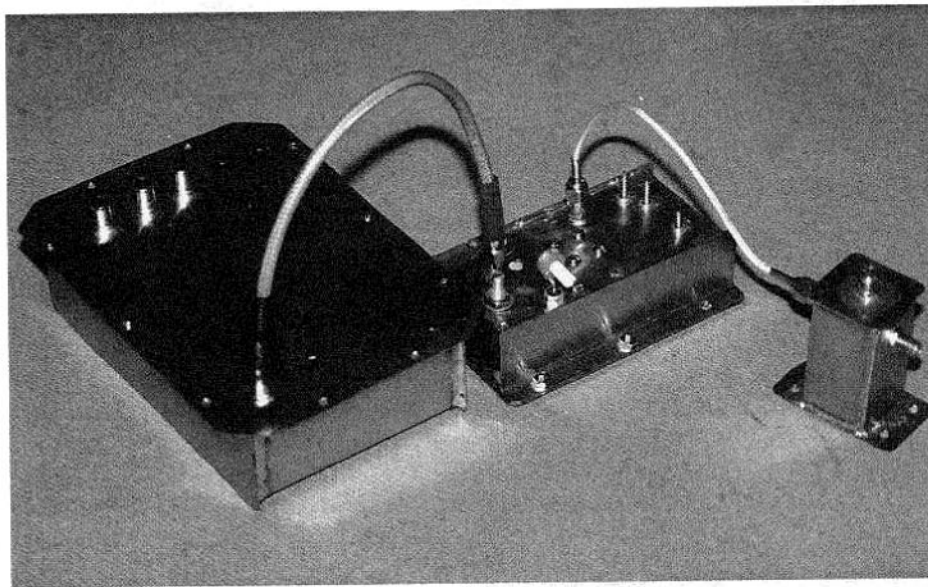


Figure 1 TA-451, tripler and filter.

Right after Dayton '99, I proposed to several AMSAT Board members that "we" should be working on ways to promote satellite usage to a much larger portion of the Radio Amateur population. The end idea was to share the cost of new projects over a broader base, i.e. create a new market. This article describes experiments undertaken with the aim of building an L-band uplink for less than the cost of an "HT." L-band was chosen because it might end up being the uplink of choice for Phase 3D, and surplus S-band downconverters for the receive side of a Mode LS are plentiful and inexpensive.

This is not a transverter article. The units described generate DSSC (double sideband suppressed carrier) or SSB directly at 1.2 GHz, with acceptable carrier and sideband suppression of 30 to 35 dB.

Does this sound marginal? A satellite downlink signal 30 dB above the noise level is pretty rare based upon the author's experience with the LEOs and poor ol' AO-10. And as long as the carrier and the unwanted sideband are in the noise, what's the point of wanting better? On my IC-821,

30 dB is S9 on the meter. And remember, this is a cost driven project.

The uplink will require some small ability to change frequency, if only to get out of someone else's way. I therefore chose an exciter with a 12 MHz crystal, and hoped that I might be able to pull the crystal a kHz or so, for a vfo range of 100 kHz at the final (1.2 GHz) frequency. Based upon my limited experience on AO-10, 100 kHz seemed sufficient.

I chose as the starting point the TA-451 exciter by Hamtronics. This \$99 kit incorporates an audio system with soft limiter which was useful later on in the project. It builds and tunes easily and can also be purchased assembled. If I had known how little L.O. power would be necessary to make this project successful, I might have attempted to convert the last stage of the TA-451 to a tripler instead of building a separate varactor tripler. As it is, I severely detuned the TA-451 to provide the required output level. A PTC-50 varistor was sweat-soldered to the crystal and powered by regulated 8 Vdc. This produced acceptable frequency stability; about 10 Hz/hr at 1.2 GHz. I got about 75 kHz output frequency shift at 1.2 GHz by adjusting the frequency trimming capacitor in the TA-451. Figure 1 shows the TA-451, the tripler and filter

I make no claim that this is the most efficient way to produce a variable frequency signal at 1.2 GHz, only that it works and is reproducible.

The varactor tripler and cavity filter are from plans in the 1982 Radio Amateur's Handbook. The filter ensures a clean L.O. At 1.2 GHz and at an output of 2 dBm. The nearest spurs were 12 MHz away, and 60 dB down. Figure 2 shows an outside view and Figure 3 and inside view of the tripler.

(The tripler is somewhat unique in that it uses five 1N914 switching diodes in parallel instead of a real varactor, and can accept 6 watts CW at 422 MHz to produce 2 watts at 1.26 GHz. If mounted at the antenna, it might just be enough to let you work Phase 3D on CW.)

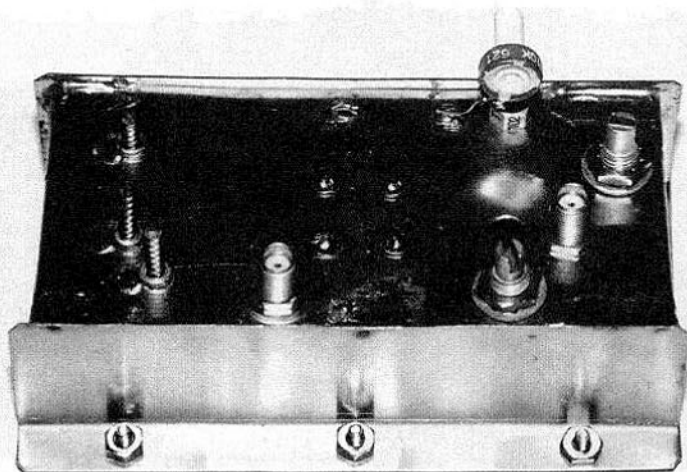


Figure 2 Tripler outside view

Audio

The TA-451 audio system is used for the two basic versions of this sideband exciter. Jerry Vogt at Hamtronics has agreed to send a marked up copy of the TA-451 schematic to anyone who requests it via jv@hamtronics.com. Brief instructions: Install and solder only one end of R16. Bring the audio out from the free end of R16, as below: This will produce clean, soft-limited audio at an amplitude of about 0.3 to 0.4 V p-p. Figure 4 is the schematic of the emitter follower.

Basic Double Sideband Suppressed Carrier Generator

(With thanks to Rick Campbell, KK7B, whose T2 SSB exciter was the inspiration for this effort.)

The DSB modulator is pure hamfest. It uses an LMX-148 Mini-Circuits mixer I bought off a table at Dayton in 1998 for \$4, two RF connectors, an RCA jack, a 200 $\pm$ ohm resistor and a 100 pF bypass capacitor. Figures 5, 6 and 7 show the photos and schematic of the mixer.

Apply the 0 to 1 dBm 1.2 GHz L.O. to the L port, 0.3V p-p audio to the I port, and you will get DSSC from the R port at -20 dBm or so on peaks, with about 30 dB carrier suppression. Yes, the residual carrier will be about -50 dBm and output will peak to -20 dBm when the modulator is unbalanced. Apply 12 Vdc through a 2700 ohm resistor to the I port to unbalance the modulator for testing. If the carrier suppression is less than 30 dB, reduce the L.O. power. If the L.O. power is too great, it will be coupled directly through the mixer and appear to be poor carrier suppression. About the best way to set the L.O. level is to unbalance the modulator and reduce the L.O. level until the output of the modulator just begins to fall, then look at the carrier suppression.

Mini-Circuits calls this carrier feed-through "L-R isolation". I originally took this specification to mean carrier suppression, which it is not. My guess is that the greater the isolation, the higher the power output of the mixer can be in this application. L-R Isolation drops dramatically at higher frequencies.

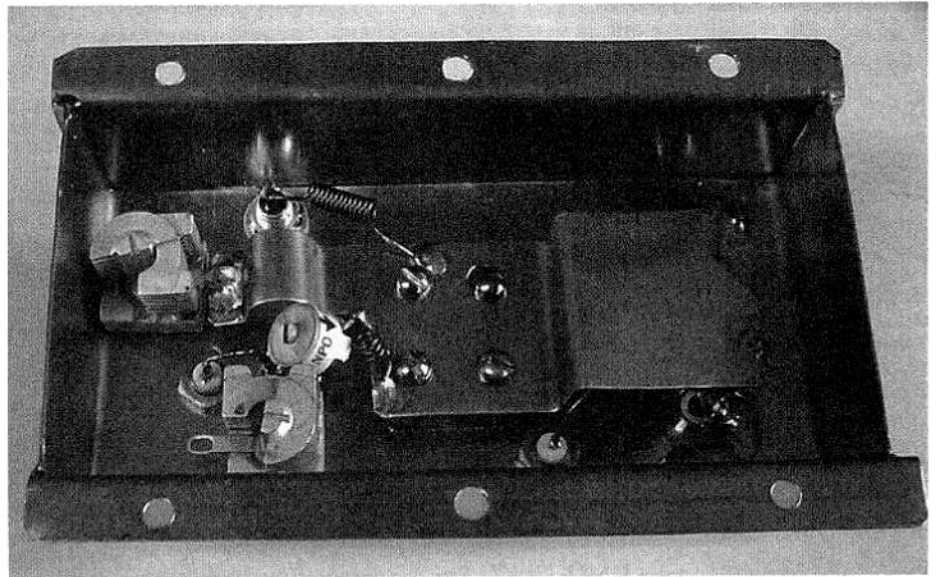


Figure 3 Tripler inside view.

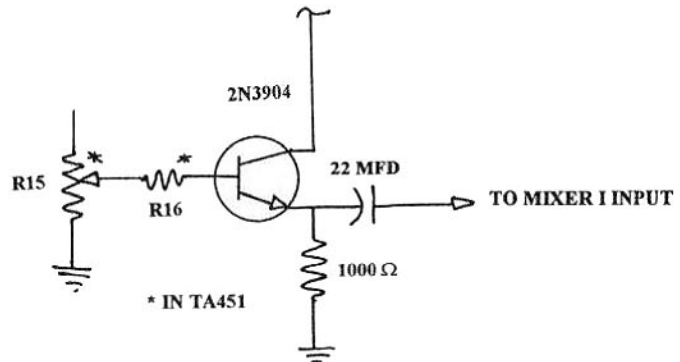


Figure 4 Emitter follower.

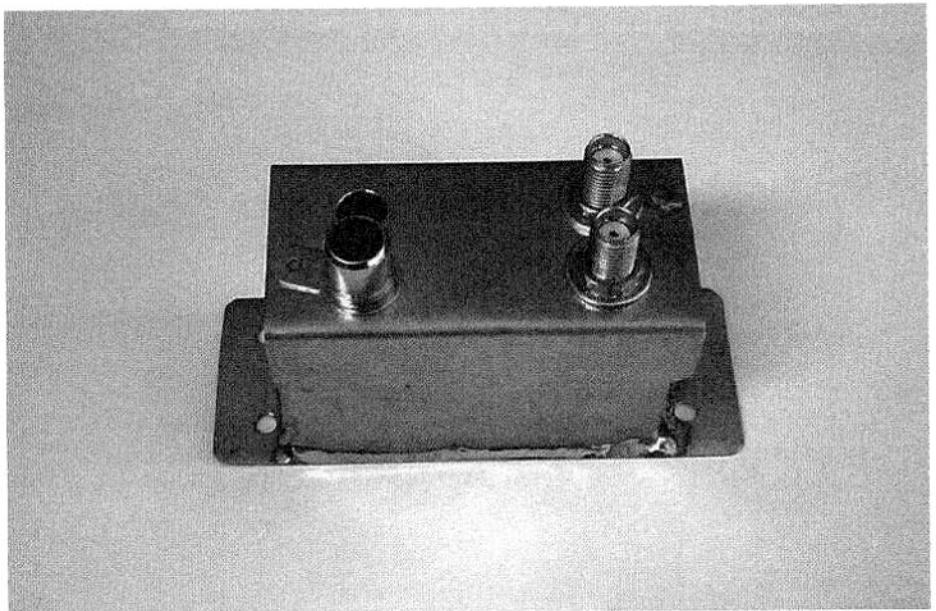


Figure 5 Mixer.

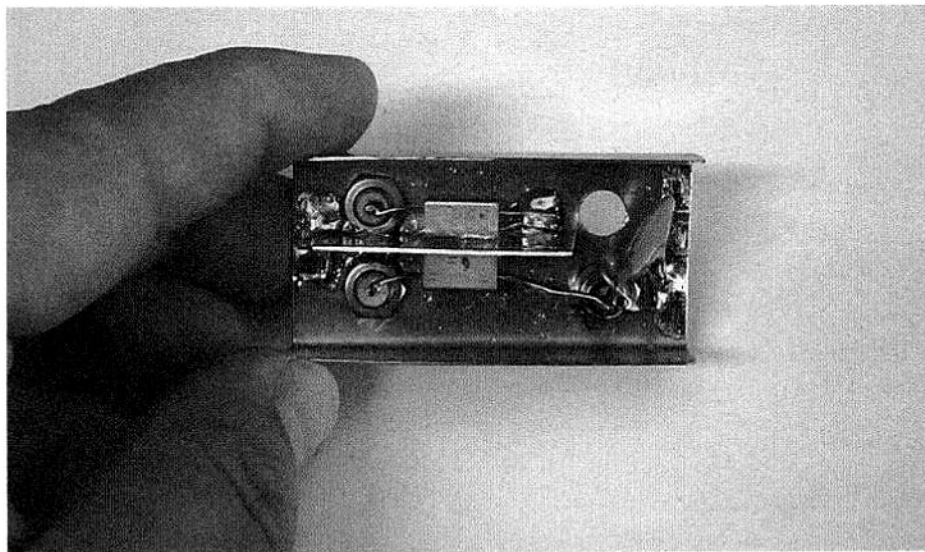


Figure 6 Mixer, inside view.

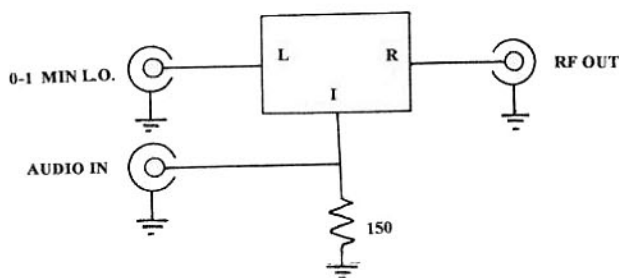


Figure 7 Mixer schematic.

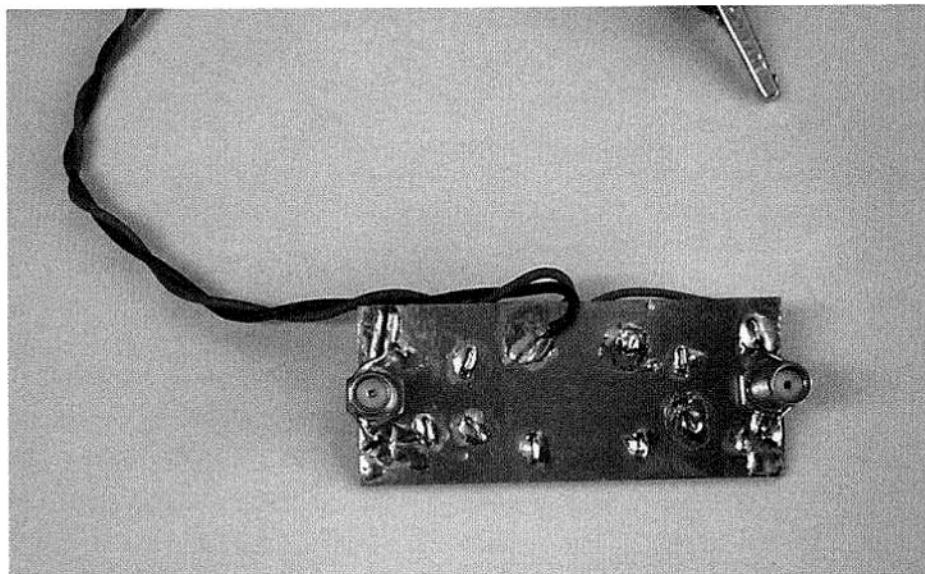


Figure 8 MMIC amp.

What About Real World Power to Drive a Power Stage?

Since the output signal peaks at -20 dBm, we will need at least 30 dBm gain to drive a "brick" to a reasonable power level. A MAR-6 followed by a MAR-2 MMIC will drive a MAV-11 to that level. Pictured below is the 2 stage amplifier I used to do my testing. It yielded 18 dB gain, more than enough to help in carrier and later in sideband suppression measurements. Figures 8 and 9 show the MMIC amplifier.

Double Mixer Configuration

To get the full story, read the Radio Amateur's Handbook section on Phasing Type SSB exciters. Briefly, you drive a pair of balanced modulators (mixers) with two RF signals which differ in phase by 90 degrees and you modulate the mixers with two audio signals also with a 90 degree phase difference. Depending upon the combination of RF and audio phases, you get upper or lower sideband output.

The most difficult part of creating SSB directly on 1.2 GHz for me was obtaining the 90 degree RF phase shift. Mini-Circuit's Application Department was a huge help here. Mini-Circuits manufactures a tiny phase shift network designed to do the job for \$6.95 in small quantities. Part number HPQ-15W yields a useable 91.87 degrees phase shift at 1.26 GHz.

The mixers chosen were model TUF-5LH, available for about \$10 each. I made an impedance-matching combiner from 1.625" long pieces of Belden 8218 (75 ohm) coax. (Measure the length of the shielded portion of the cable, and do not include the length of the leads.)

Figure 10 is the double mixer bottom showing the HPQ-15W. Figure 11 is a top view and Figure 12 is the schematic of the mixer.

"Almost" SSB

Note: This is a proven design, reprinted from *W1FB's QRP Notebook*, reprinted with permission of the ARRL. I have not completely tested it.

Use the audio output of the TA-451 to drive the phase shift network and connect the outputs to the I ports of the mixers. This network will yield 90 degrees of phase shift,

perhaps 30 dB of sideband suppression at 1000 Hz, and useful suppression between 500 and 2000 Hz. This is not great as suppression goes, but it should improve the overall efficiency of the system as compared to double sideband.

I wonder how long would it be before anyone listening on the S-band downlink would recognize that neither of the above configurations were producing true SSB ???

Figure 13 is a schematic of the audio amplifier with R-C phase shift network.

Real SSB Exciter

Buy and build a KK7B T2 phasing exciter kit, less mixers. Connect the audio outputs to the I ports of the dual mixer unit shown above. Carrier and sideband suppression will both be better than 30 dB, and the audio will be excellent. Note: the available receiver had insufficient selectivity to measure single tone sideband suppression, normal speech was simply not discernible, while the wanted sideband was peaking S-9. In addition, provisions are made for mixer unbalancing for tuneup, CW operation, PTT, and a sidetone. The T2 is an excellent value at \$66 less mixers.

Choosing the Mixer

Use a mixer which is specified to 1500 MHz minimum, Level 5 (5dBm L.O.) or higher, and which has a good high-end L-R isolation specification (25 dB minimum). The Mini-Circuits TUF-5 series worked well for me. And make sure that the IF is rated down to DC. Metal cans are probably preferable to plastic, unless you can get a great bargain, in which case be prepared to do some extra shielding between input and output.

Conclusions

- Old technology, retro techniques, and modest expectations can be combined to build a 10 mW L-band DSSC exciter for about \$200, an "almost SSB" exciter for about \$230, and true SSB exciter for about \$300. These costs will be lower or higher based upon the condition of your junk box and how well you shop your local hamfest for parts and connectors.
- Certainly these prices can be reduced, and the project made simpler. One

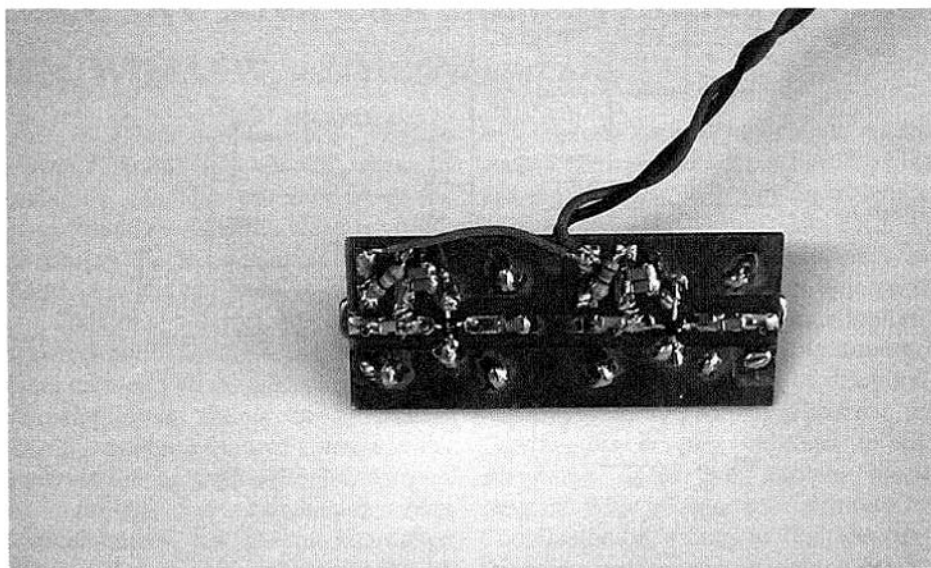


Figure 9 MMIC amp.

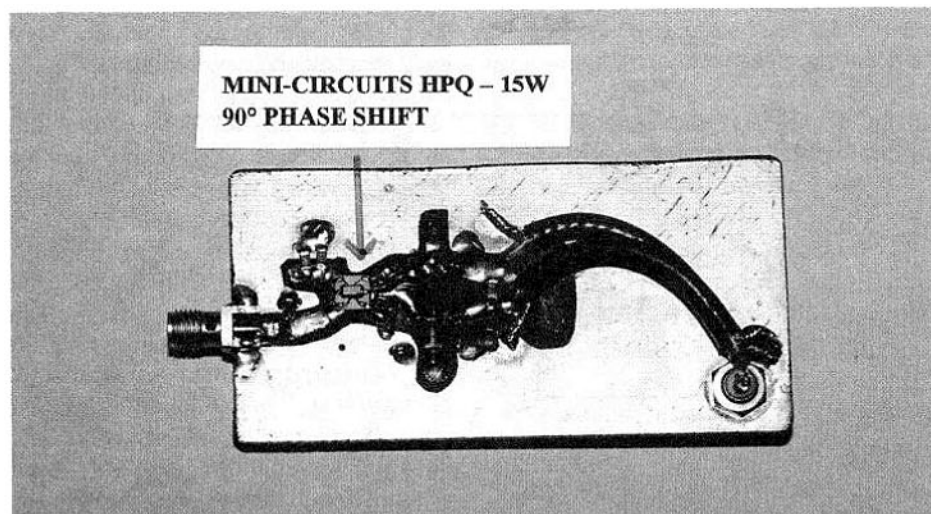


Figure 10 Double mixer bottom showing HPQ-15W.

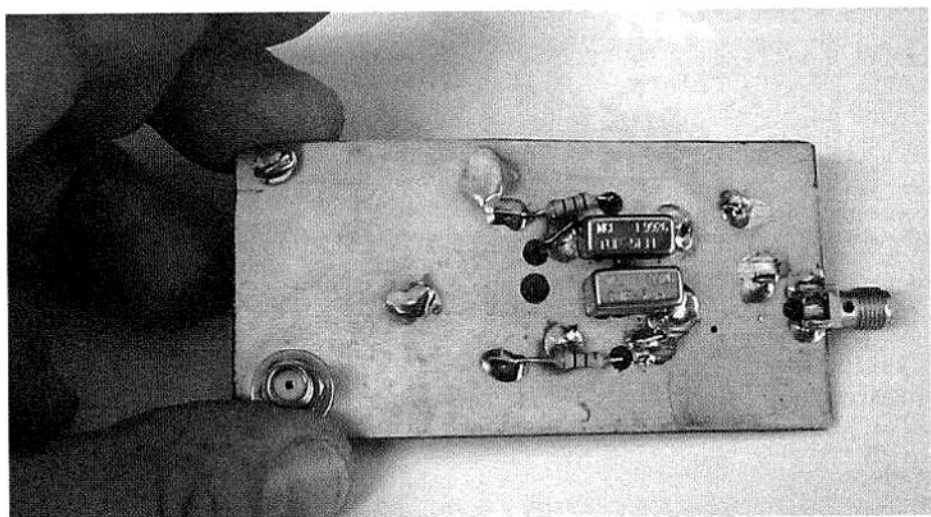


Figure 11 Top view of mixer.

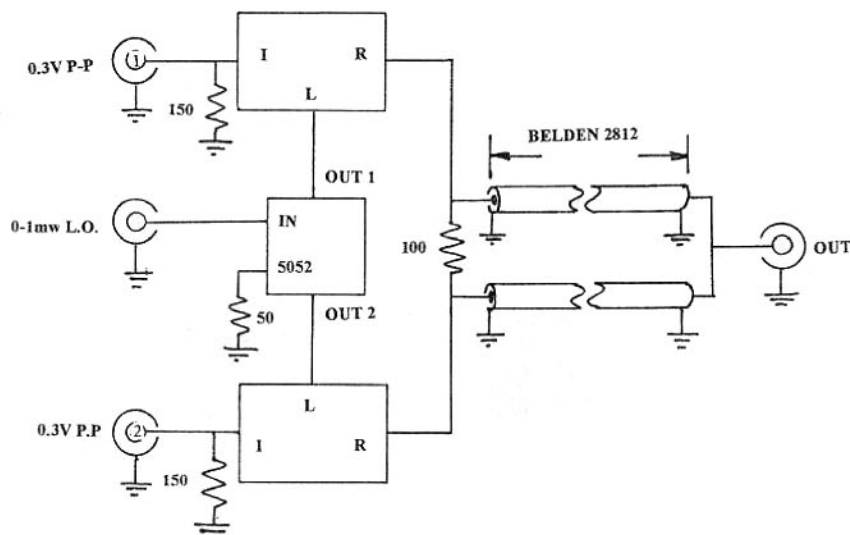


Figure 12 Mixer schematic.

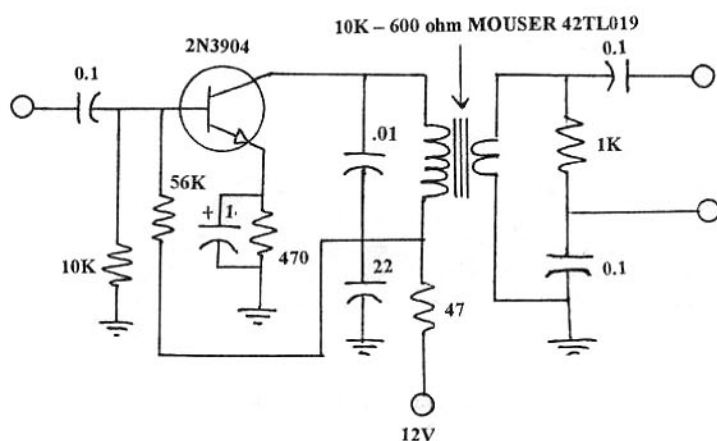


Figure 13 Schematic of audio amp with R-C phase shift network.

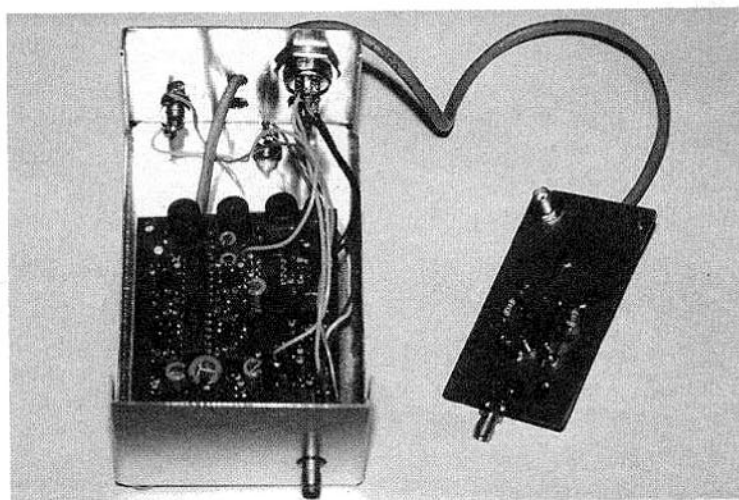


Figure 14 Photo of T2 exciter connected to double mixer.

area ripe for cost reduction is the tripler. A 2 watt output tripler is laughable overkill when all you need is 1 mW.

- We need someone to develop a CHEAP 1 watt output amplifier to drive a 20 watt brick without going through an expensive 2 watt brick. Any ideas out there? Anything on the surplus market? Phase 3D is estimated to require 12 watts and a 14 dBi antenna. (Make that 17 dBi for DSSC)

Credits

Thanks to Mini-Circuits for their several forms of help; Kanga US for selling the T2 exciter less mixers; and Jerry Vogt at Hamtronics for answering my several questions regarding power output and frequency control. Special thanks to Bdale Garbee N3EUA, my son-in-law, for the use of his extensive and excellent collection of HP test gear. As I told him when I left Colorado Springs, now the numbers in this article will probably be accurate.

Final Comments

How far I go with this concept depends entirely upon the amount of interest it generates. I recognize that this article is an overview, and that several of the components demand further testing, and/or their own how-to articles. Several of those who are interested will want to know how to build and align the exciters without needing thousands of dollars of test equipment. Others might feel more comfortable if the projects could be built on an available printed circuit board. I sincerely solicit your questions and suggestions. ■

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Field Ops Update: AMSAT Area Coordinators Listing

Barry A. Baines, WD4ASW, wd4asw@amsat.org

Once again we present our annual listing of AMSAT's Area Coordinators. In this issue you will find a listing of the 159 Area Coordinators in the US, Canada, and US Territories (plus 3 country representatives) who donate their time and energy to help represent AMSAT within their respective communities. These volunteers may give programs to local clubs, serve as 'Elmers' to folks getting started in amateur satellites, and establish AMSAT nets on local repeaters. Other activities that Area Coordinators have done include organizing local AMSAT gatherings and supporting AMSAT Field Day activities. They serve as 'Ambassadors of AMSAT' in that they become the local contact for people needing information on the amateur satellite program. Through close coordination with AMSAT Corporate Secretary Martha Saragovitz, who provides AMSAT banners and materials when requested, they represent AMSAT at hamfests and swapmeets as well as lead AMSAT presentations at these gatherings. A number of volunteers have done AO-27 demonstrations at hamfests which always generate interest and enthusiasm and which demonstrate to their communities what the amateur satellite program is all about.

AMSAT has been blessed by a number of people who have stepped forward to volunteer as Area Coordinators around the country. We currently have Area Coordinators in 48 states and 4 Canadian Provinces, as well as Guam, Puerto Rico, and the US Virgin Islands. Given the need to show the flag throughout North America, we continue to look for volunteers everywhere. You will note that there are two states where we don't have a designated Area Coordinator (South Dakota and Wyoming). There are nine other states in which there is only one Area Coordinator. Even in states where we have multiple Area Coordinators, we still lack Area Coordinators in heavily populated areas and we do not enjoy an even distribution of Area Coordinators around a given state. Field Operations representation is particularly needed in areas such as California (Los Angeles), Florida (Panhandle), Illinois (Chicago), Massachusetts (Springfield - West), New Jersey (Newark and the Northern half of the state), New York (NYC and suburbs), Ohio (Cincinnati, Cleveland), Pennsylvania (Allentown - Northeast),

Tennessee (Nashville-Memphis) Virginia (Tidewater Area), and the DC area. In Canada, we can also use support in the Eastern Provinces (Quebec, Newfoundland, New Brunswick, Nova Scotia) as well as Saskatchewan and Manitoba.

The importance of having Area Coordinators in these areas as well as improving coverage in existing areas cannot be overstated. AMSAT's ability to increase interest in the amateur satellite program is dependent in part upon creating and maintaining both individual interest and general knowledge within the Amateur Radio community of using amateur radio satellites. As was noted in the January/February 2000 issue of *The AMSAT Journal*, during the past year AMSAT was not represented at several large hamfests because we didn't have points of contact close enough to take advantage of these opportunities. Likewise, when contacted by several clubs looking for local AMSAT representatives to provide a club presentation or for technical support, we could not meet their requests on the local level. Our lack of volunteers to address these situations results in failure to develop support for the amateur satellite program, lost membership opportunities, and missed revenue through distribution of AMSAT materials. More importantly, not being seen means that our message is not being heard.

An additional consideration is the availability of volunteers to serve as local contacts regarding the upcoming launch about Phase 3D to help educate amateurs of the features and capabilities of this satellite as the expected launch date approaches. AMSAT needs a cadre of AMSAT members who are prepared to build awareness of our newest satellite and provide information concerning where to find information and what is needed to prepare for using this satellite. As AMSAT-NA makes such materials available, we can use some assistance in educating the amateur population of where they can get this information and encourage new satellite operators to try Phase 3D once it is in general amateur service.

The qualifications needed for being an Area Coordinator are simple: You must be a current member of AMSAT-NA, be willing to work with people, and have an interest in representing the organization as your time

and interests permit. In order to maintain contact with members of our Field Ops Team and provide them with support materials as needed, we also require that each Area Coordinator have Internet electronic mail capability. E-mail provides an easy and cost effective avenue for distributing information, sharing ideas, and responding to requests for support. Given the variety of satellites in current use and the diversity of interests, Area Coordinators are not expected to know everything about the amateur satellite program. What is important is that each Area Coordinator be willing to find answers to questions and follow up with individuals looking for assistance. That's why we require electronic access, so that everyone can get information from other Area Coordinators and respond to queries in a timely manner.

If you are interested in serving as an Area Coordinator or learning more about the Field Organization, please contact me via:

- E-mail: wd4asw@amsat.org
- Telephone: 904-398-5185 (home) or 904-359-1933 (work)
- Facsimile: 904-399-3225 (home)■

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AL	KE4BF	Jimmy Potter	94 Widgeon Drive	Scottsboro, AL	35769	(256) 259-1199	ke4bf@amsat.org
AL	KX4Y	Dieter Schliemann	1803 Roseberry Drive	Scottsboro, AL	35769-3960	(256) 259-3900	kx4y@amsat.org
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AR	KC5MLC	Gary Hollowell	2011 Hwy 32 West	Ashdown, AR	71822	(870) 542-7158	kc5mlc@amsat.org
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CA	KD6NXL	Joseph R. Rowen	788 E. Edison Street	Manteca, CA	95336	(209) 823-5425	kd6nxl@amsat.org
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CA	WB6LLO	Dave Guimont	5030 July St.	San Diego, CA	92110	(619) 275-1495	wb6llo@amsat.org
CA	WB6OVH	Gordon Fuller	7756 Tobia Way	Fair Oaks, CA	95628	(916) 961-0576	wb6ovh@amsat.org
CA	N6SHI	Ronnie Fitch	2200 N. Beachwood #314	Hollywood, CA	90068	(323) 871-2007	n6shi@amsat.org
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AMSAT Journal Telemetry

Call for Board of Directors Nominations

It is time to submit nominations for AMSAT-NA Board of Directors. AMSAT member societies or five current individual members may make nominations of fellow members to serve a two year term. Three seats on a seven-member board must be filled this year. The board members whose terms are expiring are: Keith Baker, KB1SF; Tom Clark, W3IWI; and Andy MacAllister, W5ACM. Please be sure that anyone you nominate understands that meeting attendance is necessary. There are generally two Board of Directors meetings per year (Spring and Fall). Nominations should be marked Board of Director Nomination and

sent to AMSAT, 850 Sligo Ave #600, Silver Spring MD 20910-4703 and must arrive by June 15, 2000.

Time to Make Plans for Portland!

George (W1ME) and Caroline (WA1MER) Caswell

The 18th Annual AMSAT Space Symposium and Annual Meeting will be held at the Holiday Inn West, Portland, Maine during October 27-29, 2000. The Holiday Inn is located approximately three miles from the Portland Jetport. A courtesy shuttle to the hotel is provided by Holiday Inn.

Portland, located in southern Maine, sits on a peninsula that juts out into spectacular Casco Bay. Portland and the Greater

Portland Area offer numerous diverse activities. Whether you are walking on a sandy beach or climbing on rocks along the shore, shopping in Portland's Old Port area or at L.L.Beans in Freeport, taking the children to the Children's Museum or for a ride on the Maine Narrow Gauge RR, visiting the Portland Museum of Art or Longfellow's boyhood home, visiting the historic Portland Head Light or eating Maine lobster at a local restaurant, you will find Maine to be a destination for scenic beauty and a wealth of historic and cultural offerings.

We look forward to hosting the convention and having you visit our beautiful state. We recommend that you visit the Maine Convention & Visitors Bureau website, www.visitportland.com/ for more information about Portland's attractions and history.

Call for Papers for the 18th AMSAT Annual Meeting and Space Symposium

This is the first call to authors who wish to submit papers for presentation and publication in the proceedings of the symposium. Topics covering the diverse aspects of amateur satellite disciplines are sought from throughout the AMSAT community. If you do not wish to present a paper, but have a topic of interest, please submit the topic and perhaps arrangements can be made for presentation and publication in the proceedings.

Key deadline dates for authors are:

- **May 1, 2000 – Tentative Call Due:** Submit name and title of paper to W1ME via e-mail or postal mail.
- **June 1, 2000 – One Page Abstract Due:** Final due date for one-page abstracts. When submitting your ab-

stract, please include any time preferences when you want to present your paper. Authors will be advised by e-mail or postal mail shortly after June 1, 2000 regarding whether their paper has been accepted or not.

- **August 1, 2000 – Camera Ready Copy Due:** This is the final due date for authors to submit camera-ready copy of paper. (Authors are urged to submit their papers in advance of this deadline.) Upon receipt, papers will only be superficially edited and will generally be printed as submitted. Please refer to past Proceedings for grammatical layout of papers. Authors are requested to provide an electronic copy preferably in any version of MS Word or WordPerfect in the event a disaster is spotted which can be corrected at the last minute.

In September, authors will be provided with a tentative symposium agenda that provides the time they will make their presentations. Each presentation will be limited to approximately 20 minutes.

Please send abstracts and papers to: George Caswell, Sr., W1ME, 16 Westwood Avenue, Scarborough, ME 04074, E-mail: w1me@amsat.org, Telephone: 207-883-3362. See you in Portland this October!

UO-14 in FM Voice Mode

UO-14 was launched in January 1990 and spent its first 18 months in orbit operating as an amateur store-and-forward satellite prior to the launch of UO-22. It was then switched for use by VITA (Volunteers In Technical Assistance) who used it for messaging into Africa. Since the computer which is used for store and forward communications is no longer able to perform that task, UO-14 is no

Satellite Orbital Elements

By Ray Hoad, WA5QGD

Satellite	AO-10	FO-20	RS-12/13	RS-15	FO-29	AO-27	UO-11	MIR
Catalog Number	14129	20480	21089	23439	24278	22825	14781	16609
Epoch Time	12.14359188	12.98556374	13.18992701	13.13338177	13.20050946	13.14019103	12.94043170	13.85653757
Element Set	617	214	214	450	308	794	227	249
Inclination	27.1196	99.0292	82.9234	64.8179	98.5856	98.4332	97.9599	51.6544
RA of Node	351.0588	172.8183	301.4747	72.8808	301.5143	75.8171	339.1648	338.5818
Eccentricity	0.6016894	0.0541265	0.0028134	0.0164526	0.0350491	0.000995	0.0010231	0.0004158
Arg of Perigee	18.6452	49.0929	197.591	315.9701	270.5734	4.072	238.6149	244.6618
Mean Anomaly	356.1868	315.5763	162.4277	42.8222	85.5268	356.0544	121.4065	115.3933
Mean Motion	2.05870365	12.83261423	13.74164367	11.27534379	13.52696677	14.28014447	14.71210814	15.86632753
Decay Rate	-0.00000105	-0.00000043	0.00000002	-0.00000032	0.00000003	0.00000181	0.0000144	0.00103397
Epoch Rev	12469	46524	44825	20791	16820	32820	84932	79464
Satellite	AO-16	DO-17	WO-18	LO-19	UO-22	KO-23	KO-25	ISS
Catalog Number	20439	20440	20441	20442	21575	22077	22828	25544
Epoch Time	13.71016826	13.17735347	13.20376198	13.15994318	13.66161459	12.96653951	13.18121507	13.87228009
Element Set	286	290	324	300	0	896	761	251
Inclination	98.4657	98.4745	98.4735	98.4792	98.172	66.0813	98.4305	51.5883
RA of Node	91.5536	92.8032	92.561	93.9042	49.0112	337.4805	76.5646	212.7939
Eccentricity	0.0011692	0.0011451	0.0012032	0.0012319	0.0007564	0.0000081	0.0011106	0.0007449
Arg of Perigee	324.0183	323.9789	323.8905	323.2761	316.5641	259.3198	347.6769	76.095
Mean Anomaly	36.0228	36.0628	36.1466	36.7581	43.495	100.7804	12.4136	115.8111
Mean Motion	14.30345541	14.30514185	14.30446653	14.30580069	14.37499278	12.86333428	14.28529268	15.64329046
Decay Rate	0.00000239	0.00000273	0.00000202	0.00000243	0.00000289	-0.00000037	0.00000236	0.0003466
Epoch Rev	52066	52063	52063	52066	44557	34862	29639	6553
Satellite	IO-26	TO-31	GO-32	SO-33	PO-34	SO-35	UO-36	Phase 3D (est)
Catalog Number	22826	25396	25397	25509	25520	25636	25693	999934
Epoch Time	13.17187855	13.17743771	13.15475931	13.2232516	13.56427556	13.15197406	13.09511689	96260.25520000
Element Set	789	250	253	144	134	174	153	3
Inclination	98.4345	98.7356	98.7366	31.4426	28.4619	96.4733	64.56	60.0203
RA of Node	76.4023	90.1596	89.9852	52.1845	148.5018	255.2337	225.6346	342.7876
Eccentricity	0.0010323	0.0004347	0.0001353	0.036688	0.0007088	0.0152602	0.0032366	0.6752895
Arg of Perigee	4.9165	155.6156	141.4994	159.5059	42.4916	313.5132	319.2864	180.1221
Mean Anomaly	355.2115	204.5283	218.6298	202.0709	317.6244	45.3463	40.5808	179.5059
Mean Motion	14.28146997	14.2251108	14.22322966	14.24315578	15.04667025	14.41080857	14.73544423	1.51063698
Decay Rate	0.00000194	-0.00000044	-0.00000044	0.00000377	0.00002323	0.00000485	0.0000033	0.0002
Epoch Rev	32823	7847	7848	6357	6641	4661	3930	2

longer usable in this mode. It is however possible to use the satellite as a single channel FM voice repeater, and recently Chris Jackson, G7UNP has configured the satellite to do this.

The UO-14 FM uplink is 145.975 MHz and downlink is 435.070 MHz.

Chris plans to leave the UO-14 running in this mode for the next few weeks. If it is

useful to the AMSAT community, he states he will probably leave it running. If it isn't used, it will be switched to transmitting telemetry. Various AMSAT-BB reports describe intensive world-wide use and excitement over this re-born FM easy-satellite.

Happy 10th Birthday UO-14 - and many more!

Results of OSCAR Straight Key Night

Ray Soifer, W2RS, thanks all who participated in the 28th annual and Y2K edition of AMSAT-NA's Straight Key Night on OSCAR. Ray noted that this year's activity level seemed down a bit, as in much of Amateur Radio in general, but we all had fun. This year's Best Fist winners include Thomas Hart, AD1B; Russell Hack, NM1K; Alfred Tribble, W3STW; N4ZQ and Frank Wiesenmeyer, K9CIS. Congratulations and see you next year, hopefully on Phase 3D.

AMSAT Dines at Dayton

Ed Collins, N8NUY has informed us that he has reserved Elinor's Amber Rose Restaurant for the traditional AMSAT Friday evening, 19 May 2000 Get-Together during the Dayton Hamvention. Those who are planning to attend should contact Ed at n8nuy@amsat.org no later than 30 April 2000 to obtain a reservation. The price for this year's dinner will be \$20 per person and there will be a COD bar setup too. Those with reservations may pay Ed at the door. An AMSAT Thruster-Firing Session is planned from 1800 to 1930 local with dinner being served at 1930 hrs. Maps to the Amber Rose will be available at the AMSAT booth.

Memories of a Teacher: Geoffrey Perry, SK

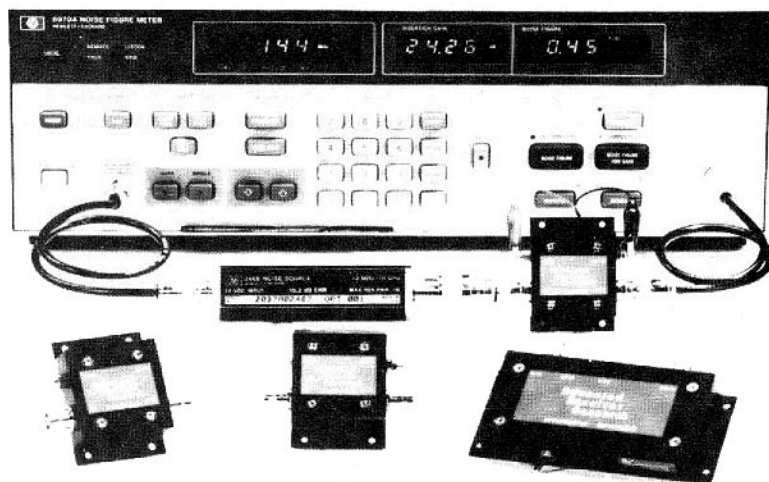
Andrew Reynolds, WD9IYT

January 20, 2000 was one of those days that stick in your mind. After two days of having the mail server refuse to connect, the line opens up at last. Off to the amsat-bb box! Open sesame, and the thing is bulging with 84 items. Well, the usual quick skim before getting ready for work will be a lot quicker this morning.....

There, though, buried off the bottom of the first display page comes up something that just sounded too bad to be anything but a joke, but "Jonathan's Space Report" isn't given to jokes.

Geoffrey Perry, dead? Since before I could remember being interested in space, Mr. Perry had been keeping an eye on space, the old Soviet Union's space activities in particular. But, there it was: Geoffrey Perry was dead of a sudden heart attack. I would later learn that Geoff had his introduction to the concept of travel in space in a spectacular way: a German V-2 had impacted a short distance from his wartime home. That

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P50VDG	50-54	< 0.5	24	+12	GaAsFET	\$79.95
P144VD	144-148	< 1.5	15	0	DGFET	\$29.95
P144VDA	144-148	< 1.0	15	0	DGFET	\$37.95
P144VDG	144-148	< 0.5	24	+12	GaAsFET	\$79.95
P220VD	220-225	< 1.8	15	0	DGFET	\$29.95
P220VDA	220-225	< 1.2	15	0	DGFET	\$37.95
P220VDG	220-225	< 0.5	20	+12	GaAsFET	\$79.95
P432VD	420-450	< 1.8	15	-20	Bipolar	\$32.95
P432VDA	420-450	< 1.1	17	-20	Bipolar	\$49.95
P432VDG	420-450	< 0.5	16	+12	GaAsFET	\$79.95
Inline (rf switched)						
SP28VD	28-30	< 1.2	15	0	DGFET	\$59.95
SP50VD	50-54	< 1.4	15	0	DGFET	\$59.95
SP50VDG	50-54	< 0.55	24	+12	GaAsFET	\$109.95
SP144VD	144-148	< 1.6	15	0	DGFET	\$59.95
SP144VDA	144-148	< 1.1	15	0	DGFET	\$67.95
SP144VDG	144-148	< 0.55	24	+12	GaAsFET	\$109.95
SP220VD	220-225	< 1.9	15	0	DGFET	\$58.95
SP220VDA	220-225	< 1.3	15	0	DGFET	\$67.95
SP220VDG	220-225	< 0.55	20	+12	GaAsFET	\$109.95
SP432VD	420-450	< 1.9	15	-20	Bipolar	\$62.95
SP432VDA	420-450	< 1.2	17	-20	Bipolar	\$79.95
SP432VDG	420-450	< 0.55	16	+12	GaAsFET	\$109.95

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realization, that humans could build something capable of going outside the atmosphere of the Earth, helped spur in interest in space and physics. As a teacher of physics at the Kettering Grammar School, Geoffrey Perry had started using space to interest his students in the different aspects of the subject. That group of school kids, and the worldwide network of friends and contacts that grew out of it, eventually went on to find out things about the Soviet military (and civilian) space program that even the experts in Western governments would learn to be true only later. Perry became the top non-government expert on the subject, contributing his insights to such august publications as *Aviation Week and Space Technology* and providing the British ITN television network with the most through knowledge of any news agency of what was happening in space. One of his earliest coups was deducing the existence of the Plesetsk Cosmodrome, and, with further detailed observations, to guess its locations to a matter of a few miles. The observations that he and his group made of radio transmissions allowed them to map out how the generic Cosmos designation for satellites was used to cover everything from

communications for the Soviet military machine to early experimental versions of what would later be termed "new" science satellites. His was also one of the first to make the sad realization that the first crew to the new Salyut space station had died in what was later determined to be an accidental opening of a cabin pressure relief valve.

There was more to Mr. Perry than just peeking over the shoulders of the Soviet space program, though. Given his wide contacts and the level of detail that they could gather, they've been called in to help out others with far less mysterious satellite work to do. As Eric Rosenberg, W3DQ remembered:

I first met Geoff at the AMSAT-UK Colloquium some years ago. We swapped information on the various commercial LEO satellite systems that were proposed and/or made it into orbit. Geoff and his colleague Max White provided invaluable assistance by listening for (and hearing) the switch-on of the Forte satellite and the ORBCOMM satellites over the last three years.

Another AMSAT member who had a chance to meet Geoff at an AMSAT-UK meeting was Martin Davidoff, K2UBC. He recalled a meeting there between Geoff and one of his old targets:

In 1991 I attended the AMSAT-UK meeting. Both Geoff and Leo Labutin (UA3CR SK) were there. On the opening day of the conference I happened to be walking into the lunchroom with Leo; we saw Geoff sitting at a table and joined him. It was the first time Geoff and Leo had a real chance to talk I mostly just sat there listening to them discussing the history of the Soviet space program. It was one of the most interesting, exciting, memorable experiences Amateur Radio has given me and one I'll always treasure.

AMSAT member Robert McGwier, N4HY remembers meeting Geoff Perry and the way people reacted to him:

When Geoff came over to be a speaker at an AMSAT banquet years ago, before he retired to Bude, he stayed with me for a while. I arranged for him to speak at three-letter institutions. He gave talks to packed houses. He received affirmation of his scooping

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those that should have known about the location of Plesetsk. Some of them remembered him well. They were still wiping egg off their faces. I have never seen so much delight on a person's face. He was a terrific person to Shann, the kids, and I. My kids still talk of him today on occasion even though it has been ten years since they have seen him. Of all the people I have met and things I have done in my association with AMSAT, getting to know this man stands right at the top of my list.

Dr. Tom Clark, W3IWI, recalled Geoff's interest in the Amateur Radio satellite scene and the doings of AMSAT.

Even though Geoff was not an amateur, he followed AMSAT's exploits with almost as much interest as he followed the Russians. It was in that context that I met him (by mail). Shortly after I published my original ORBIT software in 1980 (for the youngsters out there — this was a general purpose satellite orbit predictor written in BASIC and sized so that it would run on an 8080 with 16 kbytes of RAM), Geoff contacted me for help to allow the software to be useful for his students. And he was most pleased that I had chosen to publish the algorithms as what we now call "open source" so that the students could better understand the math."

Phil Karn, KA9Q remembered that Geoff was also willing to learn when someone came along with something new as well. He remembered how after giving a presentation on the orbital dynamics of the Phase 3 satellite, and why it wasn't a good idea to make the shift from GTO to the final Molniya orbit in one jump, Geoff came up to Phil:

Geoff wasn't aware of this fact, so he hadn't been able to figure out why the Soviets did plane changes in several stages, changing the perigee each time. For manned spacecraft circling just outside the atmosphere, the effect I described would be present even on small plane changes. Once he understood the danger I described, he immediately connected it with this puzzle he said he had lying around for some time. He really made me feel good about helping him solve it.

I never had the chance to meet Mr. Perry myself, only to read of him, his group and the fine work that they did. Bob McGwier, I think, hits it on the head though, when he referred to Geoff Perry as *A Life That Mattered*. There are few enough who can contribute as he did, and fewer still who

actually do. His presence in AMSAT will be missed.

38K4 Satellites

Stacey E. Mills, W4SM

If you're tired of the slow 9k6 baud satellites, now may be a good time to look into what it takes to go to the 38k4 downlinks. At least two of the current satellites, TO-31 and UO-36 have this capability. Phase 3D's RUDAK has multiple high speed modems and is likely to be very active at 38k4, as well. Several of us have been working with Chris Jackson, G7UPN to tweak WISP to function best with these new satellites, and I believe that they (at least UO-36) will be widely available soon. Even now UO-36 is often transmitting at 38k4 baud over the US on 437.025 MHz during daylight hours.

The uplink on these satellites is 9k6 baud, so if you're active on UO22/KO25, etc., no changes are needed on the transmit side. However, the extreme bandwidth of the downlink at 38k4 necessitates some receiver changes as all of the current ham rigs are too narrow banded to handle this. There is very good, relatively inexpensive solution, however. Symek (www.symek.com), a German company in Stuttgart, makes a small receiver/demodulator board that

intercepts the data stream from your transceiver's IF. These IFD boards cost DEM 235 (about USD \$122). They come with excellent installation instructions (in English if appropriate) and are available for most of the major satellite transceivers and receivers used by amateurs. If you don't see your rig listed, drop them a note and they'll work with you to get you an IFD board. I ordered using a credit card over the Internet and my modules were received in a few days. I've installed one in a Yaesu FT-736R and another in a Kenwood TS-790A. The Yaesu installation is very simple and the Kenwood is only a little more involved. Anyone comfortable making the 9k6 baud modifications should easily be able to handle this. Importantly, normal function of the radio is not affected.

With regard to a modem that will handle 38k4 downlinks, there may be several options. I've been told that a standard G3RUH 9k6 FSK modem can be adapted to run at this speed. There's also been discussion that a DSP56002EVM board is capable (just) of running at this rate and some software may be available for this modem on the TAPR web site. I have not pursued either of these solutions, so I can't comment further.

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Symek has two very high-speed modems (up to 614K baud!) that work extremely well. One is a two-port version (TNC3S) and the other, less expensive one is single port (TNC31S). These can be ordered from the factory in any specified configuration. I have the less expensive TNC31S. Mine is set up to wake up in KISS mode with 38k4 downlink, 9k6 uplink, and a 57k6 PC connection.

The downlink at 38k4 on UO-36 is really spectacular! Watching the byte counter fly by is quite a treat. Efficiencies of 90-100 percent are easily obtained with directional antennas and a preamp. Doppler tuning is not really necessary on the widebanded 435 MHz downlink. Downloads of 1.5 Mb are possible on a single pass, and all three components of a color image can be captured in short order. I used to think 9k6 was fast, at least compared to 1k2 on AO-16, now when I look at KO-25/UO-22, the byte counter seems to be moving in slow motion! To me at least, this high speed (Internet level) transfer rate, and the ability to grab images on a single pass, really brings some excitement back to the digital sats.

Hope to see you in the queue(s) soon. 73 de W4SM

APRStk Satellite Tracking

Bob Bruninga, WB4APR

APRStk has satellite tracking embedded into APRSdos. It is the first satellite program to auto-tune your Kenwood D7 or D700 for automatic downlink capture. A new version has been posted to the WWW which incorporates the following improvements:

- Adds ISS and MIR and the recent OPAL to the Keplerian elements.
- Autotunes the Kenwood radios to the downlinks.
- Converts TLM packets to HEX so binary data doesn't mess up screens.
- Adds NAVSPASUR 217 MHz radar fence to maps so you can listen for radar pings when satellite crosses the line!
- APRStk.ZIP is now posted to include a full-up APRSdos INSTALL. Please use PKUNZIP -dn or WinZIP for a full install.
- ASTK-EXE.ZIP is an upgrade for existing APRSdos users. Also use PKUNZIP -dn to get everything.

Just run APRStk, set the squelch on your D7 or D700 radio connected to a 20" whip antenna that can see the sky with minimum coax loss, and the rest is magic! (The use of the Kenwood TH-D7 is for digital satellite downlink reception only. That is, this is just for fun. It does *not* pretend to be a full-up

satellite station program, however you will be amazed how many satellites are flying overhead all the time.

- For more information see: <http://web.usna.navy.mil/~bruninga/astars.html>
- Complete APRStk download: <ftp://tapr.org/aprs-sig/dosstuff/APRSdos/aprstk.zip>
- For APRSdos Users: <ftp://tapr.org/aprs-sig/dosstuff/APRSdos/astk-exe.zip>

Again, this is a downlink monitoring application only. It is not a full-up satellite station control program. But here are the satellites you will hear on your FM radio:

- UO22
- KO23 (when it is working)
- KO25
- TO31
- AO27 (voice)
- SO35 (when in voice mode)
- OPAL (a weak brief burst once every 10 seconds)
- AO16, LO19, and IO26 are authorized for APRS use but require UHF SSB radios and PSK modems for the downlink.

Over the Horizon with RS-13

Frank Cahoy, K0BLT

In one day, I wanted to test all three RS-13 passes for more possible over the horizon propagation into Europe from my QTH in central Nebraska. However, I fear that my best opportunity (third pass of the day) was missed. My first pass was not much to report in that the beacon was not readable until the bird was almost at AOS and the beacon was lost at just -10 degrees elevation. It hadn't even reached Western Europe before it was totally gone. However the next pass was much more fruitful. For my location, it was

an almost overhead pass (80 degrees maximum elevation) and the beacon peaked at an S7 (with no pre-amp) and continued very strong as LOS was reached. I began calling CW CQs as the bird reached Europe. I kept checking the beacon and it remained very strong and very little QSB. When the bird reached -20 degree elevation I still had no takers and I was fearful that I wasn't getting into the bird. (I'm using an FT-890 single transceiver on Mode K, so there is no way I can monitor my own down link.) I tuned up into the SSB portion of the RS-13 bandpass and found SM7WSJ a beautiful Q5 S3 calling CQ. I called and we exchanged all the necessary information with great copy at both ends. I made sure he was actually working RS-13 and it wasn't a 15m simplex QSO. At the end of this contact the bird was at a -30 degree elevation but the beacon was still quite readable. One last CQ on CW raised Dan, OK1DIG for our 2nd QSO in as many days. It was quite marginal and not as solid as the day before but we did manage to exchange greetings and signal reports. At -40 degree elevation the bird was totally gone.

Later that day, I had a luncheon meeting and when I got home I managed to reach the shack just as the third pass beacon was fading and gone. I should have skipped dessert! The beacon was still Q5 at -45 degree elevation but totally gone at -50 degrees elevation. Perhaps my days off next week will be as gratifying. Probably not in that the morning passes will be considerably earlier and the propagation on both 15 and 10 will not be as optimum as these past two days have been. We shall see. I hope you LEO satellite operators find this interesting and join in!



Another clue! Lou McFadin, W5DID reports that there were no correct (some close) answers to the What Does This Do for Phase 3D Contest. Here's another photo of the equipment in question. Send your guess to w5did@amsat.org. The correct answer will win an AMSAT t-shirt!

AO-27 from St. Croix

Steve Thompson, K5PK

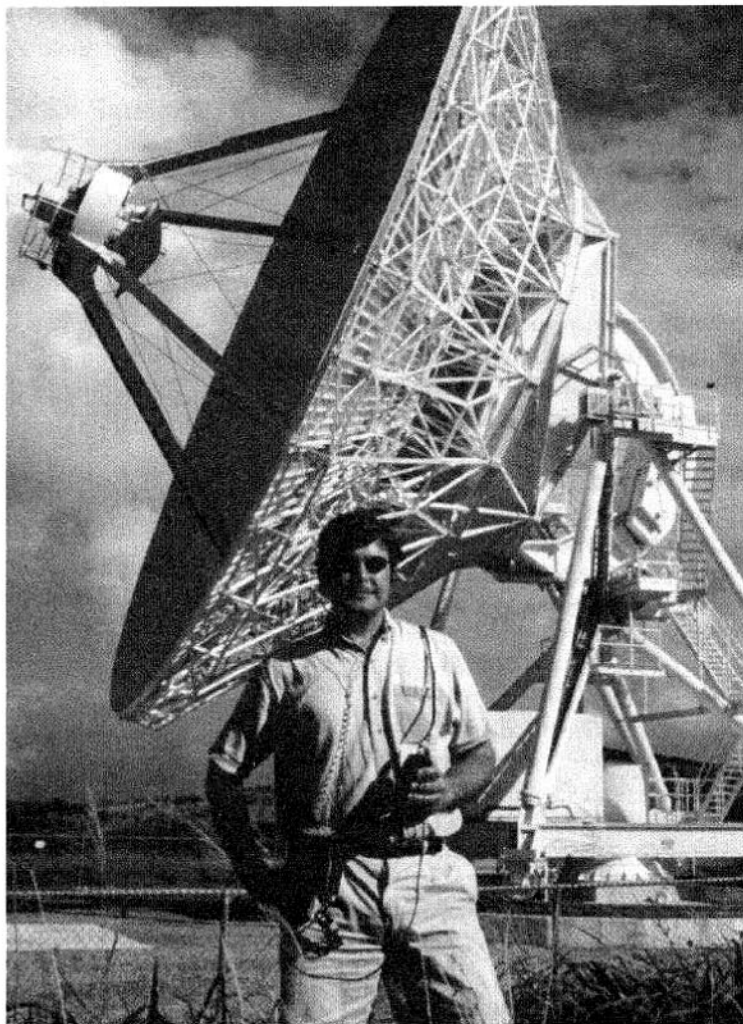
Thanks for all the great contacts over AO-27 from St. Croix while on vacation. I wish I could have worked everyone who called. It was a lot of fun and a real challenge working as many station as I could in the shorter than normal five minutes the bird was available before it would shut off. At times depending on where I was standing, the wind would whistle through my lightweight headsets while the tape was rolling and recording your transmissions. So for those of you who at least heard me respond to your call even if not quite correctly, I played the tape back after each pass and sorted out your correct call. For what it's worth, I am going to try to e-mail wave files of your contacts or attempted contacts to those of you I can hear on my taped log. Also I have made a custom color QSL card containing photos of the surroundings where and at the time your contacts were made. Here are the stations worked:

Date	Station	Time (UTC)
1/23	K5OE	14:39
	WB4FWQ	14:40
1/24	Off the air and doing vacation type things.	
1/25	KF4FDJ	13:45
	XE2YVW	15:23
	KF4FDJ	15:24
	VA3PK/6Y5	15:25
1/26	Off the air diving & petting Nurse Sharks.	
1/27	KB8WCJ	14:25
	KC8LGL	14:26
	W8JOM	14:27
	VE3UEX	14:31
	N3ZLL	14:28
1/28	KB8WCJ	13:57
	AC3A	13:58
	KB2WQM	14:00
	W4EPI	14:02
	KC8LGL	14:03

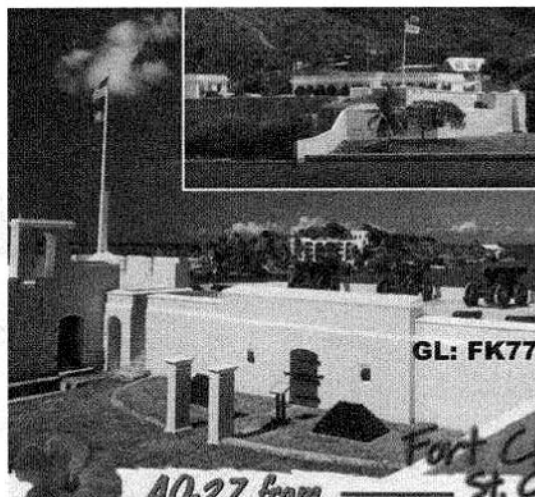
The following are stations *heard* from St. Croix (I will also produce a HEARD ONLY card, so be sure to send for yours as well):

Date	Station	Time (UTC)
1/25	K4AQL	15:23
	K0LEE	15:25
1/27	N5YAV	14:28
1/28	VA3SS	13:58

During each pass I had to work quickly because of the restricted availability dictated by AO-27's onboard TEPR timer settings which basically gave me only half a pass to make any contacts. So I sometimes made three or four contacts per pass using my big 5-watt H.T and Pryme Radio Products RD-98SMA extended dualband whip. An ARROW antenna it ain't but it's especially exciting when I make these kind of contacts using next to nothing.



The day before K5PK arrived at St. Croix, he and his family made a stop just south of Arecibo, Puerto Rico where they got the expanded tour of the 1000 foot radio telescope dish antenna and as a bonus, got to see Jodi Foster's cabin style love nest from the movie Contact. The above photo shows K5PK in front of a dish antenna on St. Croix that is part of the "Very Long Baseline Array" or VLBA that is used for astronomical studies. K5PK mentions that he wishes he could say that's what I used for my AO-27 contacts but the whip worked almost as well...yea right.



GL: FK77

Fort Christianvaern
St. Croix, U.S.V.I.

K
5
P
K

QSO WITH	DATE	UTC	FREQ.	RST	MODE
KF4EKY	01 25 00	15:25	21.70m	5 x 5	J-FM

K5PK's Special QSL Card.

Amateur Satellite Frequencies In Use

Compiled by Andrew Reynolds, WD9IYT and Michael Seguin, N1JEZ

All Frequencies in MHz

AO-10	145.825 —	145.975 Downlink	SO-35	145.825 Downlink FM only (note 2)
(note 1)	435.180 —	435.030 Uplink		436.291 Uplink
		145.810 Beacon		145.825 Parrot repeater
RS-13	29.460 —	29.500 Downlink Mode KA	AO-16	437.0513 Downlink 1200 baud PSK
	145.960 —	146.000 Uplink		145.900, 145.920, 145.940 Uplink FM
	21.260 —	21.300 Uplink		2401.1428 Beacon
	29.460 —	29.500 Downlink Mode A	LO-19	437.150 Downlink 1200 baud PSK
	145.960 —	146.000 Uplink		145.840, 145.860, 145.880 Uplink FM
		29.450 Beacon		437.125 CW downlink
		29.504 Robot Downlink	IO-26	435.822 Downlink 1200 baud PSK
		145.840 Robot Uplink		145.875, 145.90, 145.9250, 145.950 Uplink FM
RS-15	29.354 —	29.394 Downlink	UO-22	435.120 Downlink 9600 baud AFSK
	145.858 —	145.898 Uplink		145.900 Uplink
		29.352 Beacon	KO-23	435.173 Downlink 9600 baud AFSK (note 3)
FO-20	435.800 —	435.900 Downlink		145.850, 145.900 Uplink
	146.000 —	145.900 Uplink	KO-25	436.500 Downlink 9600 baud AFSK
		435.795 Beacon		145.980 Uplink
FO-29	435.800 —	435.900 Downlink	TO-31	436.925 Downlink 9600 baud AFSK
	146.000 —	145.900 Uplink Analog		145.925 Uplink
		435.910 Digital Downlink	UO-11	145.825 Downlink only, 1200 baud AFSK
		145.850, 145.870, 145.890,		2401.500 Beacon
		145.910 Digital Uplink	UO-36	437.025 Downlink only
		435.795 Beacon		437.400
		435.910 Digitaltalker		
AO-27		436.795 Downlink FM only		
		145.850 Uplink		
UO-14		435.070 Downlink FM only		
		145.975 Uplink		

Notes:

1. AO-10 continues to operate without on-board batteries, so availability limited by sun exposure.
2. SO-35 FM repeater available on weekends only. SO-35 also transmits on 2.250 GHz, live PAL video, but only over South Africa. SO-35 is also due to enter mailbox/digipeater service. Check ANS for further developments.
3. KO-23 is experiencing battery problems and is in intermittent use only.

Human Space Flight Frequencies

Suggested ISS Frequencies

Suggested 2 Meter Downlinks:

- 145.800 MHz.
- Special Events and Emergency Only 145.8125 and 145.990 MHz.

Suggested 2 Meter Uplinks:

- 144.490 and 145.200 (Region 1 Auxillary) MHz.
- Alternates: 144.470 and 144.450 MHz.

Suggested 70cm Segments:

- Segment 1: 437.500 - 438.000 MHz.
- Segment 2: 435.700 - 435.800 MHz.
- Duplex Operation: 435.700 - 435.800 MHz with 2.2 MHz offset.

Mir Frequencies

- FM Simplex: 145.985 MHz.
- Short-Term Experiments: 435.725, 435.750, 437.775, 437.925, 437.950, 437.950, 437.975 MHz.

ICOM IC-821H

"By far the easiest to use satellite radio on the market today. In less than 10 minutes after unpacking the IC-821H, I was on the air at 9600 baud with KO-23."

— Michael Wyrick, N4USI and AO-27 Control Operator



It's 2 RECEIVERS IN 1 COMPACT BOX.

Enjoy full crossband full duplex operation. Use the independent RF attenuators, RIT, IF shift circuits and scan functions. Each band also has its own S-meter, squelch, volume control and independent mode selection.

"SATELLITE FRIENDLY" OPERATION.

Better than just using a high/low setting, the continuous adjustable transmit power feature gives you precise power control. This helps extend the life of amateur radio satellites by running the minimum power necessary.

EXCELLENT SUPPORT FOR CW. An electronic keyer is built in and optional CW-narrow filters are available separately for the Main and Sub bands. Also get: adjustable keying speed and dot/dash ratio, adjustable delay time for semi break-in operation, and more.

ICOM options required for PC connections:

CT-17 CI-V Level Converter



Other options also required for PC connections:

Third party serial cable, pins 1-8 & 20
Third party software

DUAL DISPLAY
Shows receive (downlink) and transmit (uplink) simultaneously.

SPECIFICATIONS

Transmit: 2 Meter, 440 MHz (70 CM)
Receive: 136-174 MHz, 440-450 MHz
(guaranteed 144 - 149 and 440 - 450 MHz only)
Mode: SSB, CW, FM
Power: 2M SSB: 6-35W, continuous
2M CW, FM: 6-45W, continuous
440 MHz SSB: 6-30W, continuous
440 MHz CW, FM: 6-40W, continuous
Power Supply Requirement: ... 13.8 V DC
Memory Channels: 160 Total,
80 Channels Per Band
VHF Antenna Connector: ... SO-239 (50)
UHF Antenna Connector: ... Type-N (50)
Size: 9.5(W) x 3.7(H) x 9.4(D) in.
241(W) x 94(H) x 239(D) mm.
Weight: 11.0 lb
5.0 kg

FEATURES

- **Continuously Adjustable TX Power**
 - More control
 - Extends satellite life by using minimum power
- **Independent Main / Sub Band Rx**
 - Tuning, AF and squelch level, and 4 function control switches per band
 - In Satellite mode, Sub is uplink, Main is downlink
 - IF shift for either Main/Sub band
- **9600 or 1200 BPS Packet Capable**
 - Direct audio modulation
 - Excellent C/N ratio
 - Excellent frequency stability
 - Adjustable ACC modulation signal levels
- **High Frequency Stability**
 - ± 3 ppm standard, ± 0.5 ppm optional
- **100% Duty Cycle**
- **AF Speech Compressor** for increased average talk power
- **Auto Repeater** with one-touch repeater functions
 - Built-In RIT Function
 - Built-In Electronic Keyer
 - RF Attenuator
 - Noise Blanker
 - Tone Encoder (CTCSS)
 - Separate Speaker Jacks
 - 1 jack per band
 - AGC Time Constant Control
 - Auto Repeater Function
 - Rugged ICOM Construction
 - Built-In CI-V Port
 - 2 Optional CW Narrow Filters



NOISE BLANKER
Reduces pulse-type noises

INDEPENDENT CONTROLS
For Main/Sub band

QUIET FAN
Keeps things running cool and quiet

Tx/Rx FREQUENCY TRACKING
Normal / reverse shift

A FEW NOTES FROM THE QST EXPERTS:

"(The IC-821H) is a terrific dual-band multimode transceiver for all applications. Not only is the IC-821H an excellent VHF/UHF weak signal or contest radio, it is the cornerstone of a high performance satellite station (digital or analog). Hams who have the Phase 3D satellite in mind will want to give serious consideration to the IC-821H. It also offers superb FM-voice and 9600-baud packet performance. Combine all of these features with the IC-821H's go-anywhere size and you have a radio that's ideal for almost any application above 144 MHz!"

— QST Magazine, 3/97

For REAL satellite performance, there's only one rig to seriously consider...the IC-821H. Contact your authorized dealer today, or call for a free brochure:
425-450-6088

ICOM
www.icomamerica.com